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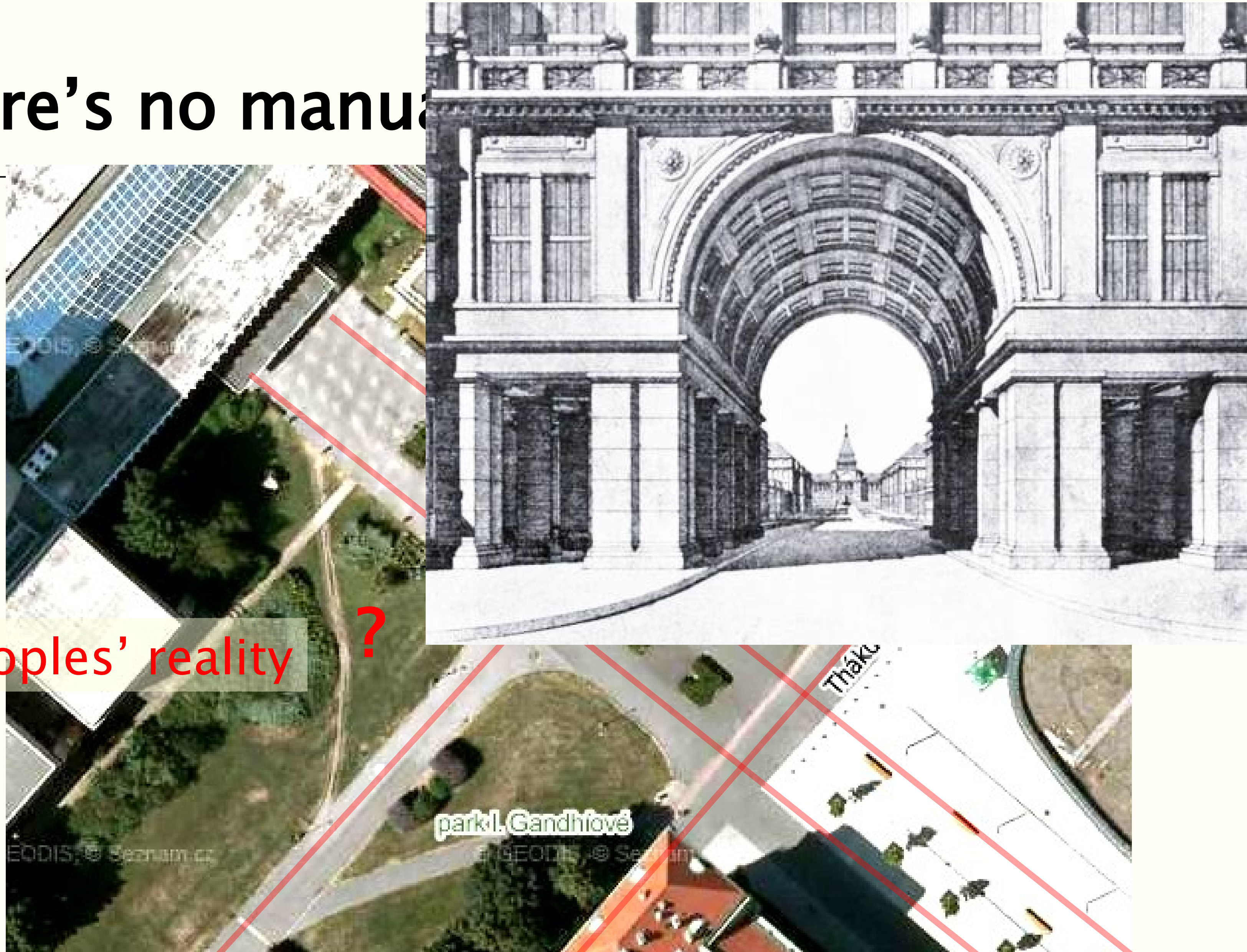
# 1. What is HCI and why do we care?

- Designing *for someone*
- User Centered Design
- Usability and User Experience as a discipline
- Trust and ethics

# There's no manua



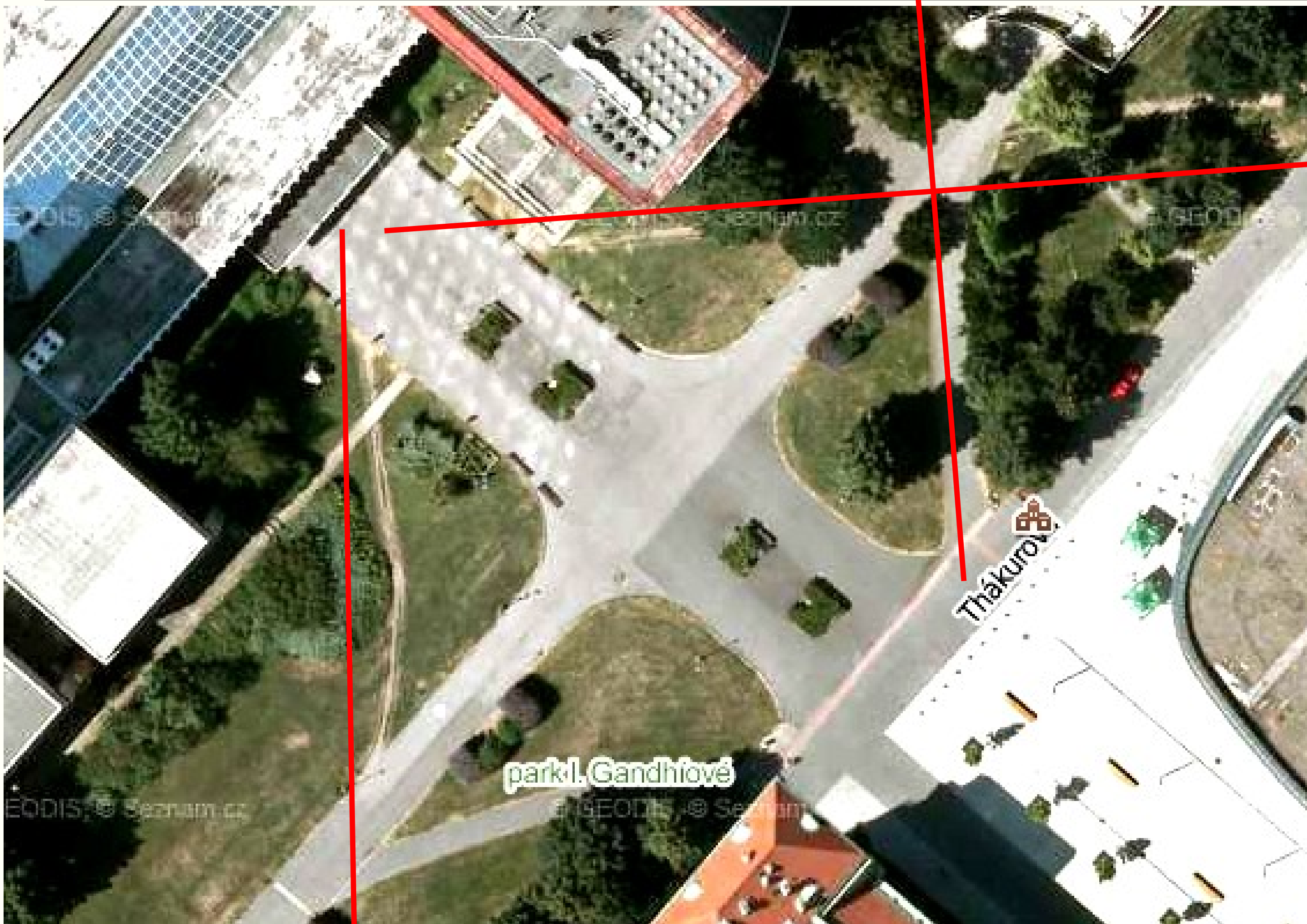

peoples' reality ?

architect's ideas

# One solution (the simple one)

# Another one: to research and to understand

a former parking lot




restaurants
U Pětíka
U Švejka
U Topolů

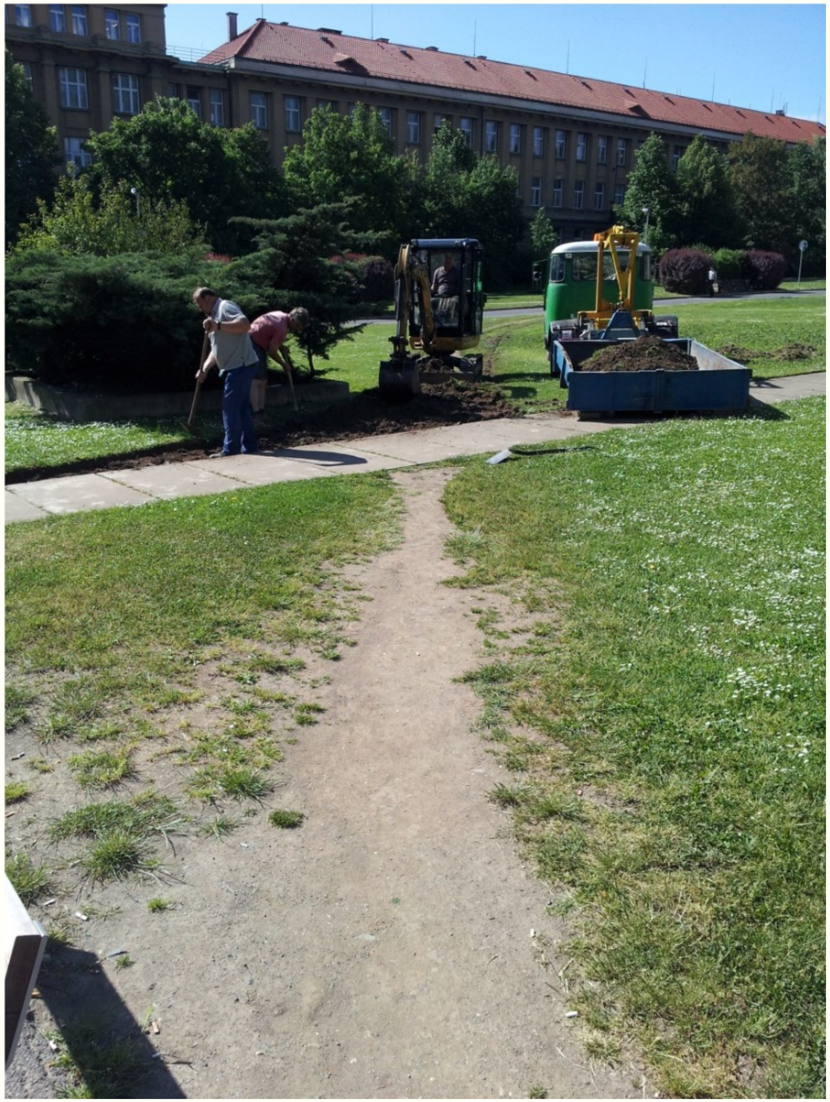
restaurant
Pod Loubím

# Critical evaluation of the research

- The results explain the observed phenomena, but..
- … aren't they biased?
- Another expert →slightly different results (explanations by the presence of medical centers and pensioners' homes)

- This cannot be avoided in social sciences
- It is better to accept the fact
- Than to pretend it does not exist

# A happy end?



Yes, a happy end.
The problem:
how **not** to modify a finished artifact by an excavator?

# Another twist...

Someone turned one of the paths into a sculpture.

**Welcome to the world of man-machine interaction.**

# To research, to understand, to respect


- The park was constructed in about 2015
- Still has no “user” paths
- Respects communication paths through it

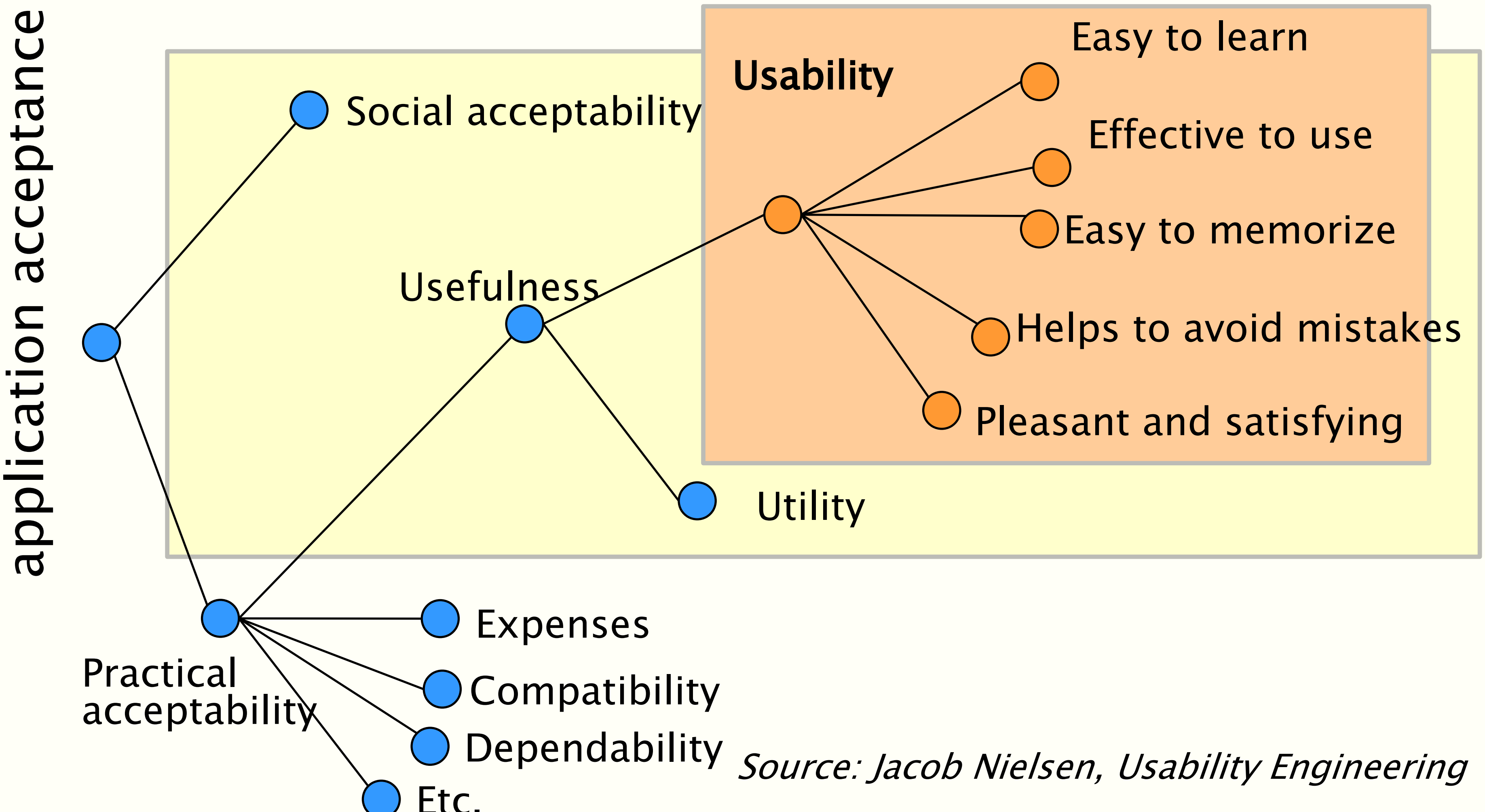
# A great pitfall: introspection

- There may be people who enjoy marching in **rectangular paths**
- However, it may be observed that there are people who enjoy **shortcuts**
- And that observation should be **respected** in the design

# Something for someone

- In the position of
  - an architect, a craftsman, …
  - → **a designer**,
- to design, to construct **something**
  - an application, a device, a document, a house...
  - → **an artifact**
- for **someone**
  - a user, a reader, a consumer, an inhabitant …
  - → **a user**,
- so that it is **usable** and gives **satisfaction**

# What is “usable“?




*Source: Jacob Nielsen, Usability Engineering*

# User Centered Design

- An attitude towards the user
- A perception of the user
- Many methods
  - **to research**: get data
  - **to understand**: interpret the data
  - **to respect**: project the understanding into design
  - **to collaborate**
- Not a local folklore:
  **ISO 9241 Ergonomics of human-system interaction Part 210: Human-centered design for interactive systems**

Human-centered: because the design affects more people than just the direct users

# Common phases of UCD

- Context and task analysis – the **formative phase**
  - User research – abilities, preferences, habits, activities...
  - Domain and environment research  (physical, technical)
  - **Testing** the designers' understanding
- Design – refining prototypes
  - Information architecture
  - Logical structure
  - Visual design
  - **Testing** the prototypes
- Testing – **the summative phase**
  - Final usability testing
  - Observing how the artifact interacts with society

# The important feature: user orientation

- Long (~30yrs) evolution: emphasis on different aspects
  - Many methods, variants
  - Many formalisms, diagrammatic aids, …
- A cross with a theory of design: **Design Thinking**
  - **Empathize** – drop your own assumption, get insight
  - **Define** – elaborate on a problem statement
  - **Ideate** – generate ideas, innovate
  - **Prototype** – formulate the ideas to all others, as early as possible
  - **Test** – verify the ideas
- Creative techniques, discussions, moving targets lead to an emphasis on **iterative work** and **phase overlapping**

Interaction Design Foundation

# Stakeholders

[ISO/IEC 15288:2008]

- **Stakeholder**
  An individual or an organization having a right, share, claim or interest in a system or in its possession of characteristics that meet their needs and expectations, for example:
  - The people who will **use** the solution **directly** (end-users);
  - Those who provide them information or use their output (**indirect** users);
  - Those who **manage** them and are responsible for their success (managers);
  - Those who **purchase** the product and may have their own, quite independent, criteria.

Karen Holtzblatt and Hugh R. Beyer

# Stakeholders: examples

- **of a www site:**
  - its **owner:** to have as much ads as possible
  - its **administrator**: to keep traffic as low as possible
  - **direct user**: where is the Premier League table???

⇒ conflicts of interest

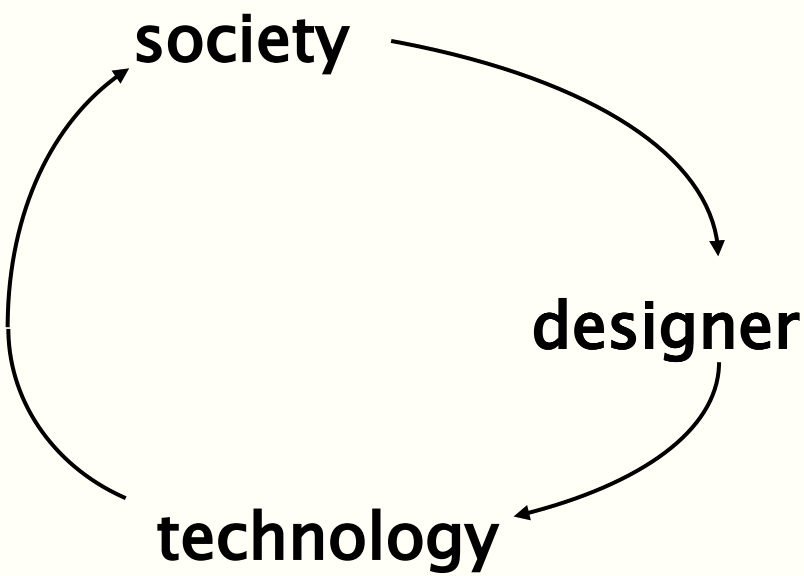
- **of an enterprise information system:**
  - **business people**: to have their defined processes implemented – something good has to happen
  - **IT people**: to minimize costs and risks – something bad must not happen
  - **the enterprise as a whole**: to satisfy customers

⇒ business and IT are partners

# Attitudes towards direct users

- To **help** them to achieve their own (conscious) goals
  - The original and still **standard HCI**
  - The design of most of professionally used artifact
  - Every design – to a degree
- To **please**, to make feel more powerful (and cause emotional links to the artifact as a product)
  - Most *productized* artifacts
- To **manipulate**, to affect users' behavior in a way beneficial to another person
  - Many e-commerce artifacts
  - Ultimate examples: dark patterns

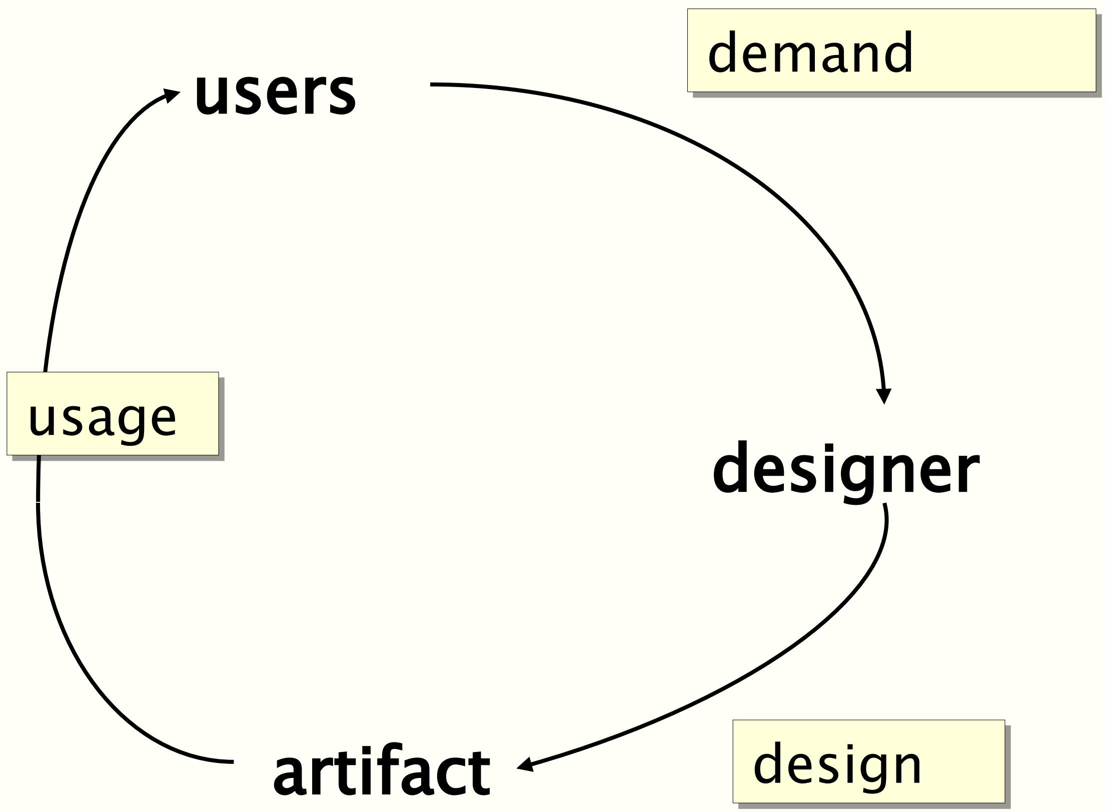
# HCI as an attitude




- One bad office app – millions of people in depressions
- Good intention
  does not matter,
  lack of knowledge hurts
- Rational work needed
- **Function of engineers in society**

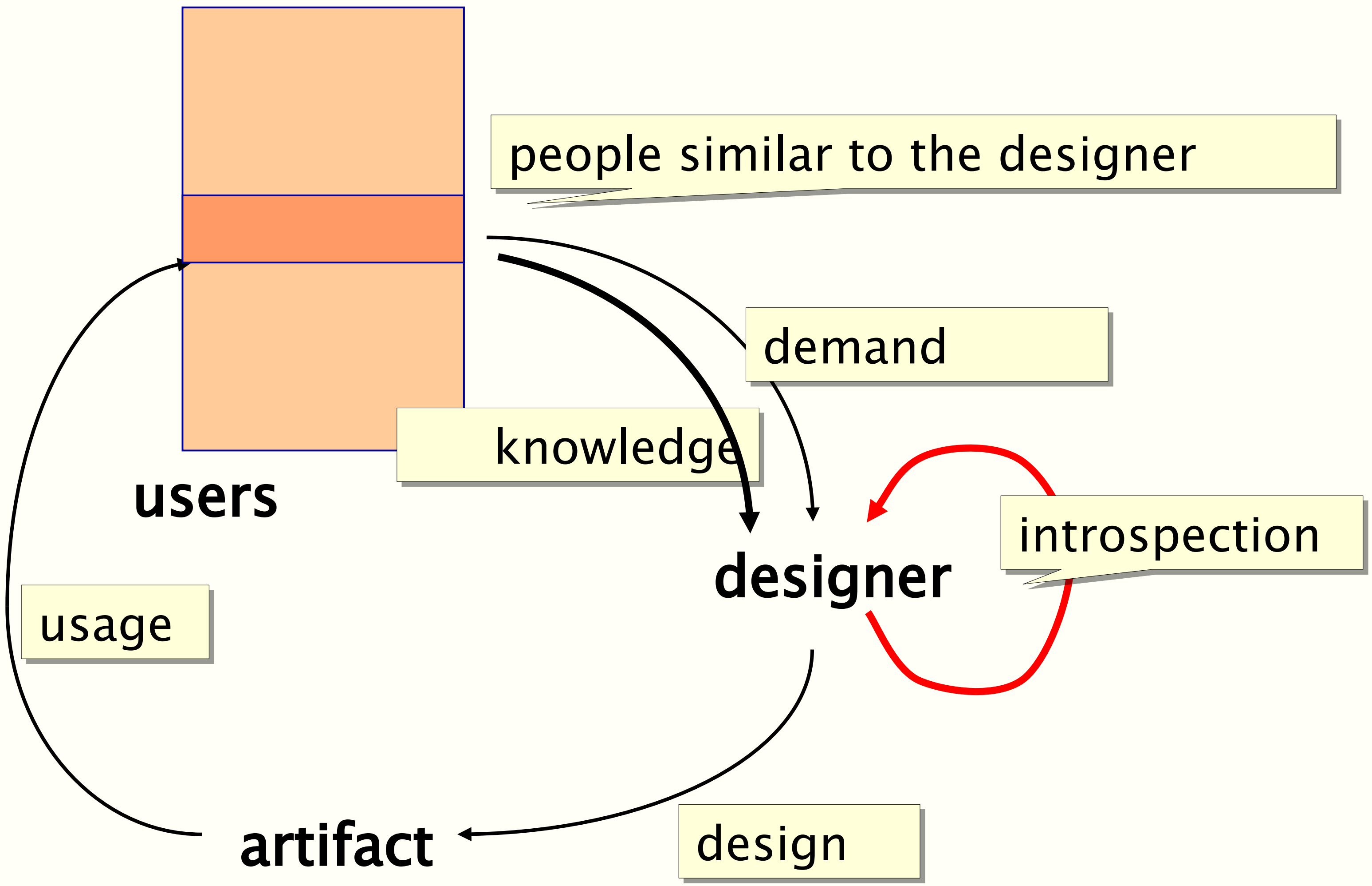
Since technology cannot be mastered by everyone,
**a bridge between users and technology**

# Artifacts, design, society



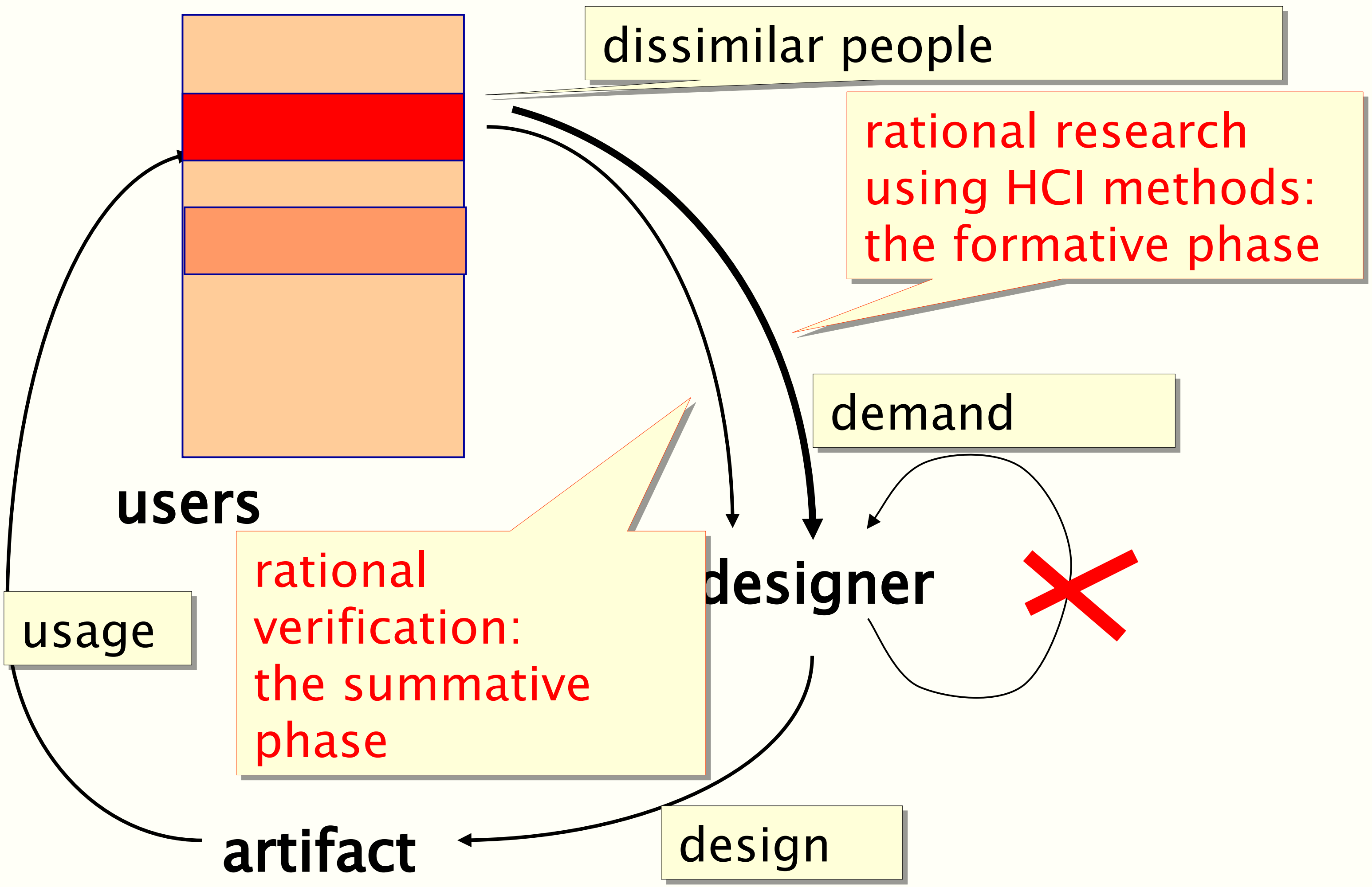
- An artifact answers a need – explicit, latent, invented …
- Designers set out to construct an artifact
- The artifact affects the society,
    - in an intended way
    - in an unanticipated, unintended way

# A design for my own tribe



- The simplest situation is when designers do something for people like them, such as
  - a programmer writing yet another source editor
  - an artist collaborating on 3D creative software
- They have – to a degree – some knowledge about such users
- They can use even **introspection** – simply design the artifact to their own liking
- Because of the similarity, the design is often useful
  - so why are there so many source editors…?

# Professional work



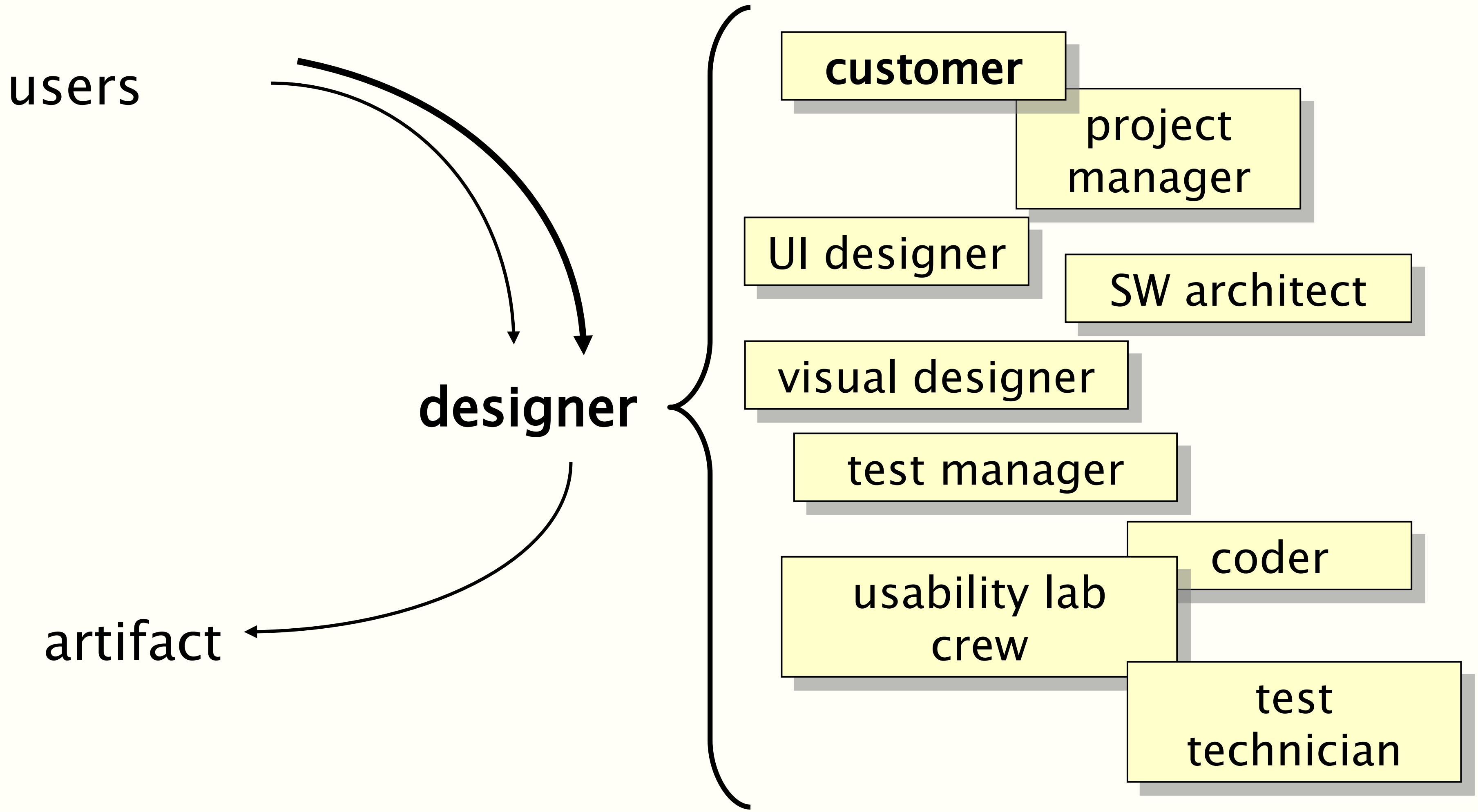
- When the users are dissimilar to designers, for example
  - in skills and background,
  - in memory and cognitive abilities,
  - in goals,
  - in preferences,

  systematic methods must be used to know (empathize, …) the users
- Introspection is highly unreliable – the designers must drop their own assumptions
- Systematic methods must be used to evaluate the artifact w.r.t. the users, and to learn its functioning in the society

# HCI as a discipline

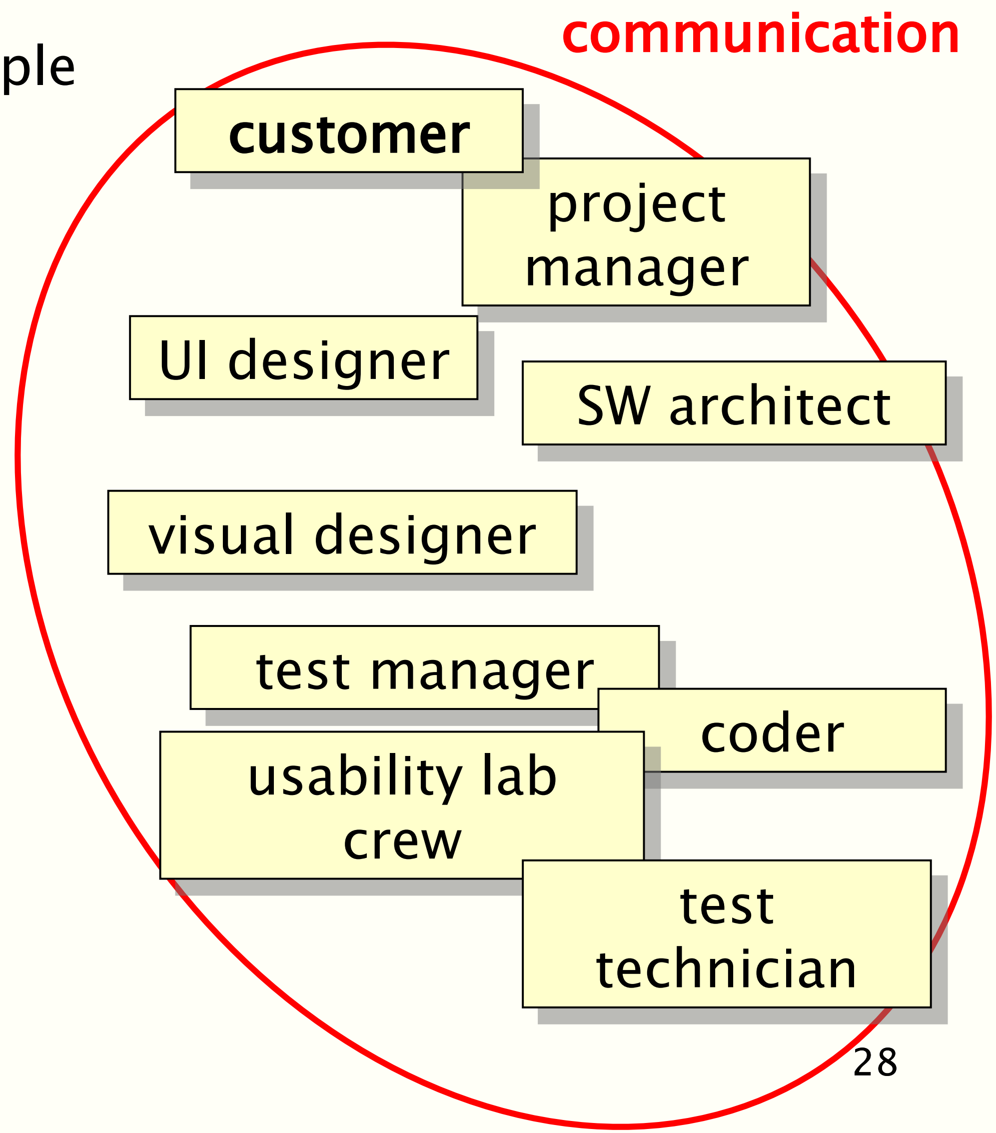
- **HCI as a branch of science**
  - theoretical foundations of practical methods
  - user modeling
- **HCI as a standard method**
  - integration into software engineering workflow
  - proven and accepted methods of design and evaluation
- HCI as an **attitude**
  - to research, to understand, to respect
  - to find a method for every situation
  - „HCI for everyone“

# HCI as a standard method



# HCI as a standard method

- Communication between people and organizations
- Mutual **trust** needed
- **Standard** (=verified and accepted) methods
- **Standard** ways of communication (forms etc.)
- **Standard work flow**



# The designer and the user: partners
## The ethics of partnership

**Goodwill**
What the information will be used for?
Whose profit?

the user
site's owner
advertising agency

**Integrity**
Are promises held?
Is the truth said?
Is the complete truth said?

also the duty to inform about any recording, observation…

**Ability to fulfill**
Are they able to protect the information from misuse?

the duty to **provably** protect confidential data

# Connotations are ubiquitous

A subjective cultural and/or emotional coloration in addition to the explicit or denotative meaning of any specific word or phrase in a language. **Emotional** association with a word.

Wikipedia

- "Architecture with a message"
- "Material (texture) with a message"
- "Layout with a message"

# HCI science: a bridge between two worlds

**Areas of technology**

Software engineering

Graphics

Web technologies

Human Computer Interaction

HCI

**Areas of social science**

Psychology

Sociology

Perception studies

Cognition studies

# HCI science:
# a variety of viewpoints

**Usability**

the ability to fulfill
tasks
performance
error level

**User experience**

emotions
feelings
liking
motivation
satisfaction
users' values

**Usability engineering**

**User experience architecture**

# HCI science: Research methods

**Quantitative approach**

Measurable quantities (metrics)

Constant and reproducible circumstances

Statistically evaluated data

Easy evaluation

**Looks scientific**

**Can miss principles**

**Qualitative approach**

A priori theories not useful

Naturally occurring circumstances required

No mechanical way to understanding

Understanding not easy to communicate

**Looks unreliable and unscientific**

**Can discover real causes and principles**

# How does it fit into software engineering

- **Software engineering**
  - understands and manages application life cycle
  - starts with requirements
  - evaluates conformance
- **User centered design**
  - understands and supports users' goals
  - researches requirements
  - evaluates artifacts use
- Requirements and evaluations:
  natural meeting points between SW and HCI
- Each step of software development has its evaluation – and that can incorporate HCI
- The more modern the software engineering method, the better it converges with UCD

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# USER RESEARCH AND COLLABORATION


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2024

1.1


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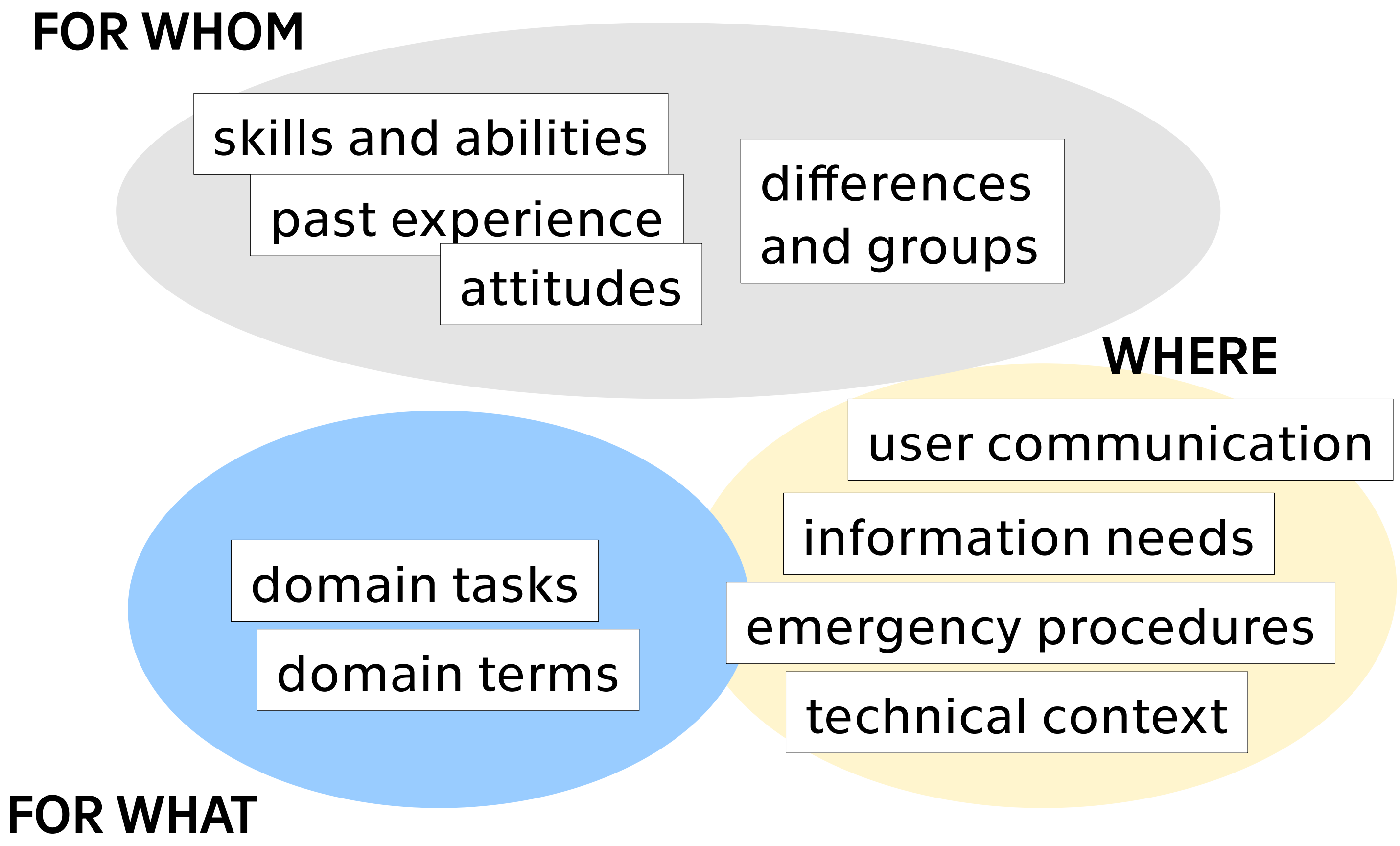
https://courses.fit.cvut.cz/BIE-TUR

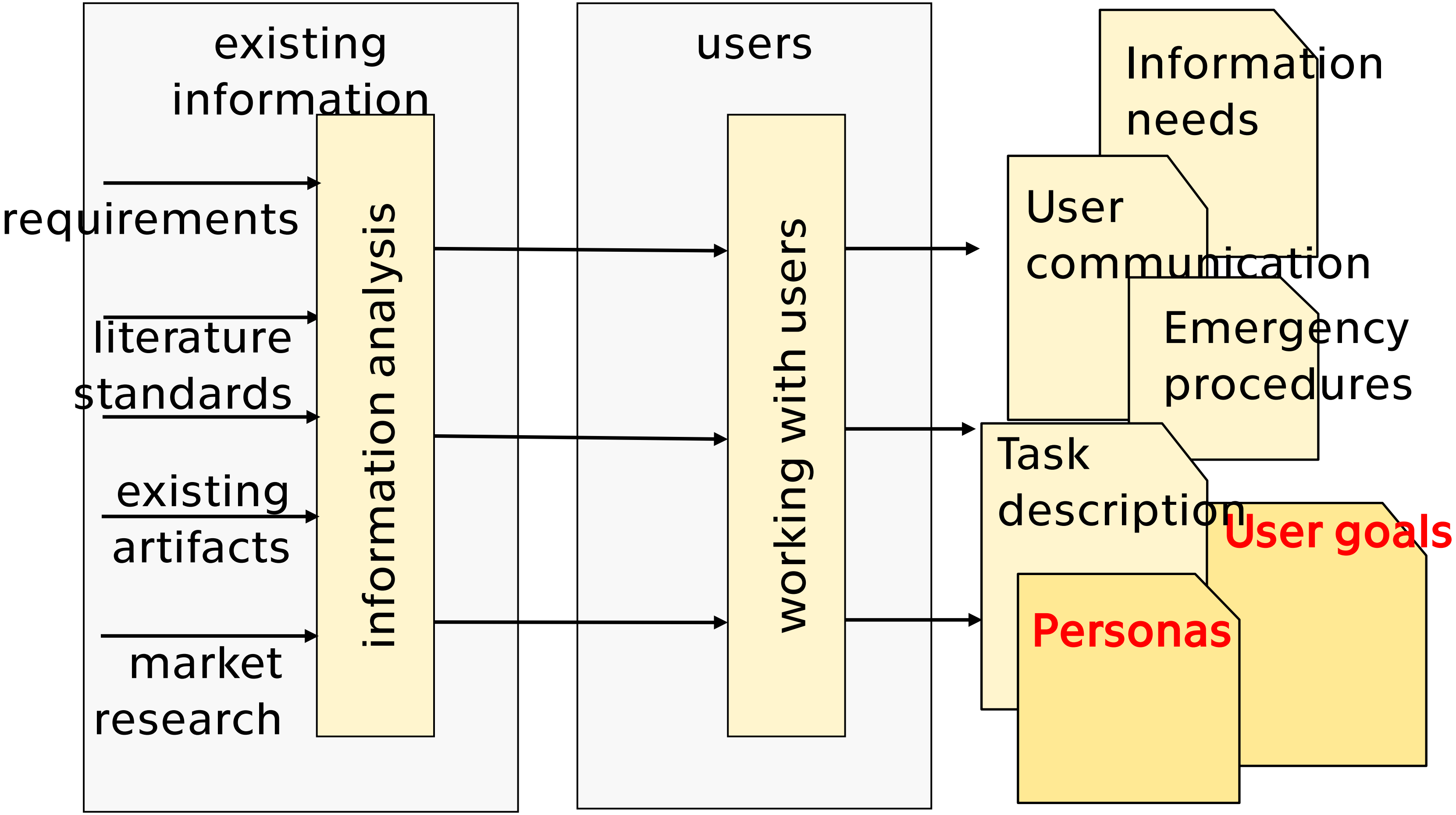
# Context analysis



# Usability context

- Anything that directly or indirectly influences the use of an artifact
- Examples:
  - **who are the users**
  - **what information do they need for decision making, achieving their goals, …**
  - **how do they communicate among themselves**
  - **what activity does the artifact support**
  - **what are accepted emergency/failure operations**
  - how frequently do the users interact with it
  - what is the environment
  - what other artifacts are used in connection

# Two phases


existing information
requirements
literature
standards
existing artifacts
market research
information analysis
users
working with users
Information needs
User communication
Emergency procedures
Task description
User goals
Personas

# USER RESEARCH

# What do we need to learn

- What cannot be in the information analysis
  - Skills, attitudes and other material for personas
  - How the users communicate
  - Irregular procedures
  - Information for decisions
- What is in the information analysis, but we need to confirm
  - real procedures
  - real communications
- What is hard to understand in the information analysis
  - Relative importance of various facts
  - Simple explanations of complex terms

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# Questions and answers

**understanding** the role of pornography in society

why
how improve
QUALITATIVE

**understanding** the roots of attitudes towards pornography in society

BEHAVIOR


**y %** of web accesses from the domain X are to pornography sites

how many
how much
QUANTITATIVE

**x %** of the respondents consider pornography immoral

# Whom to ask

- Your **population** are your **users** (e.g., all students of...)
- Ask the **entire** population if
  - small
  - accessible
  - cooperative
- Ask a statistically balanced **sample**
- Ask **some** sample
  - quantitative evaluation difficult
  - less reliable results

# How to motivate

- The base: **trust**
  - understanding the goal of the research
  - understanding whose profit
  - seeing that the respondent's effort is not wasted
- Intrinsic (inner) motivation
  - the need to help other people, improve situation, etc.
- Extrinsic (external) motivation
  - tangible rewards (discounts, lottery, etc.) - the need to repay
  - intangible rewards – thanks, praise

# How to ask

- Select **techniques**
  - Questionnaire surveys
  - Interview
  - Questioning in a context
  - Ethnographic methods
  - Web analysis
- **Plan** the surveys
- **Evaluate** the plan
  - pilot respondents in surveys
  - peer reviews
- **Execute** the plan

# How to do it

- What do we need to know – **the question**
  - what kind of question it is – qualitative, quantitative
  - what is it about – behavior, attitude
- How to get a relevant answer – **the method(s)**
  - can we ask it directly?
  - can we observe it in field?
- How to turn data into conclusions – **the interpretation**

# How to interpret the data

- The usual question in user research: are there different **segments** (i.e. characteristic groups) of users?
- From **quantitative** data
  - clustering, cluster analysis
- From **qualitative** data
  - typical, characteristic facts, their compatibility (manually…)
  - exceptional facts (why did they occur? what is their meaning? are they just the peaks of larger icebergs?

# Whom to tell

- Information **radiation** – purposes
  - To help formulate artifact requirements
  - To ease communication between all designers
  - To aid in reaching consensus
  - To contribute to the artifact documentation
  - To aid in promotion & sales

# QUESTIONNAIRE SURVEYS

# Surveys

- A survey is a research **process** answering research questions
- A questionnaire is **just** a tool in that survey
- Written answers to questions
  - closed question – choosing
    - one value from a scale
    - one value from a given set
    - multiple values from a given set
  - open question – answering by a free text
- The presence of a researcher
  - researcher-administered
  - self-administered

# Resulting data

- Quantitative – mainly from closed questions
  - statistical distribution of values
  - frequencies of choices
- Qualitative data – mainly from open questions
  - repeating answers with the same meaning
  - exceptional answers – meaningful or random?
- Attitudes only – cannot replace observation
- One level only – no asking for reasons, details

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# Scales

odd

| | | | | | |
|---|---|---|---|---|---|
| yes | | | | no | |
| yes | | do not know no attitude | | no | |
| strongly agree | agree | do not know no attitude | disagree | strongly disagree | universal (Likert) |
| very useful | useful | neutral | useless | completely useless | question-related |
| 1 | 2 | 3 | 4 | 5 | |

even

| | | | | | |
|---|---|---|---|---|---|
| | agree | rather agree | rather disagree | disagree | |
| strongly agree | agree | rather agree | rather disagree | disagree | strongly disagree |

# Problems to overcome

- Respondents pose themselves “in a better light” – consciously or not
  - Socially: answer what is socially accepted
  - For prestige: emphasize good facts
  - For consistency: when the purpose of the survey is detected, try to answer consistently and not to look chaotic
  - To avoid extremes
    - not to look as a fanatic
    - to prefer “middle ground”
  - For looking positive
    - negative answers look bad
  - When the purpose of the survey is detected, to “help” the authors

# Problems to overcome

- The respondents have to remember previous events
  - Recent events outweigh older events
  - Negative experience outweighs positive experience
- The respondents may not know the answers
- The respondents are affected by mood and fatigue
  - a tester's frustration in post-test questionnaire (which is OK)
  - a survey at the end of a difficult interaction – no response
  - other sources of fatigue – careless answers

# Question ordering

- Early questions should be easy and simple, unpleasant and hard questions at the end
- Early questions should be clearly relevant to the purpose
- When a large "not applicable" number of answers is expected, or other reasons exist, the questionnaire **should branch**
- Questions should go from general to special and from one entire topic to another, **if it does not contradict other aims** (cf. later)

# Question ordering

- Make it difficult to guess the purpose of the survey. Tell only enough to be ethically OK. Hide the crucial questions among others. Randomize the order.
- Leave no room to guess what will be considered consistent, use straight questions where possible.
- Ask for recent and past experience or events separately.
- Keep the questionnaire short
- Mix questions with expected positive and negative answers.
- For crucial information, use redundant positive and negative questions; do not overdo it – frustration, length

# Question formulation

- Avoid leading or loaded questions.
- Use simple language and simple syntax.
- Avoid  questions with double negation, limit questions with single negation.
- Use words with clear, specific and unambiguous meaning.
- Make options mutually exclusive.

# Question formulation

- Using even-sized scales diminishes the tendency to “middle ground”. If a neutral point is needed, join the two center values in evaluation
- The answers
  - don’t know
  - no attitude
  - not applicable

  are all different. Providing all relevant answers diminishes the tendency to answer randomly
- Using straight open question or question-related scale counters the tendency to positive answers

# Question formulation

- For unpleasant questions (requiring answers that could harm reputation)
  - instead of requiring exact numeric value (age), a range is sufficient
  - emphasis should be given on the privacy and anonymity of the survey
  - the information can be obtained from different sources
- Making easy to choose the right value from a choice, e.g., by alphabetical order, counters the tendency to choose the first ones or the last ones

# Survey timing

- The respondent should be in a neutral mood, relaxed, not in a hurry – **standard situation in user research**
- When the respondent's mood should project into the answers, do it immediately after the event – standard with post-test questionnaires
- If the questionnaire is a part of larger process, do not ask for answering when the respondent is tired or focused on problem solving – common in group techniques

# INTERVIEW

# Resulting data

- Quantitative and qualitative answers, depending on questions
- Attitudes only
- Details can be investigated
- Reactions to newly discovered facts possible

# The technique of interview

**structured**
fixed, prepared questions

- easy to interpret
- easy to conduct
- what we do not ask, we do not know

**intermediate**
- helper questions
- topics list

**flexible**
the course of the dialogue follows answers to previous questions

- able to bring surprising but substantial facts…
- … which are hard to interpret
- needs knowledge, skills, personality … of a good media reporter

# Characteristics

- A much smaller sample than questionnaires
- Better chance to understand, to gain insight (esp. flexible interview)
- An “intelligent agent” on the spot
  - can correct misunderstanding
  - can follow important leads – set the course of the interview
  - must gain trust of the respondent
  - can affect the result

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# FIELD RESEARCH TECHNIQUES

# Questioning in a context

- Characteristics
  - Qualitative data
  - Actions and attitudes
  - Details can be investigated
  - The course can follow both answers and observed actions

# Questioning in a context

- “In a context” means “in a real situation”
- Combined observation and interview
- Questions regarding the behavior of the person
  - Why
  - Why not this way
  - Is there any other way … ?
  - What can go wrong
- Thinking aloud
  - An inside view (impossible by observation only)
  - The problem of self-esteem, rationalization …
  - The problem of additional load (driving a car…)

# The techniques borrowed from ethnography

> ***drink with us or leave***
> a rule at *symposions* in ancient Greece

- Characteristics
  - Qualitative data
  - Actions and attitudes
  - Relevant insight
- The technique of participating observer
  - Observation and interpretation of a real situation
  - What people do as opposed to what they say they do
  - Real tasks, real obstacles, real motivation, real bosses…
- Demanding
  - Time, travel
  - Communication skills, personality, soft skills
- Results are hard to communicate

# Web analysis

- Characteristics
  - Qualitative and quantitative data
  - Actions
- Aggregation – a summary influence of individual actions, attitudes…
- Quantitative data: visits, logins, transactions, **conversions**
  - frequency during time
- Qualitative data: patterns of behavior
  - e.g., goal-oriented buyer, impulsive buyer

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# PRESENTING THE RESULTS

# Personas

- We've got a (supposedly) plenty of quantitative and qualitative data
- Sometimes hard to communicate
- We need to use the data to:
  - influence the artifact design
  - communicate the ideas to developers, customers, users
  - build consensus and commitment
  - evaluate the design (→predictive methods)
  - decipher web analytics (→quantitative methods)
  - help promote the artifact
- We project all the information into a fictitious person and complete it to create a consistent character - an **archetype** of the user

# Steam engineers…
# Joe “Lint” Oleman

Graduated from Polytechnic Institute in 1992. Worked on top designs of the time. His machines are known for smooth run and long life. Puts emphasis on accuracy and precision (hence the nick). Accepts new software slowly, but then is able to get the most of its features (⇒ numerous bug reports). Uses a high-performance FORTRAN library for dynamic balancing.

Joe “Lint” Oleman, Polytechnic Institute 1992

“It is our task to help the users to know what they need”

“The devil is in the detail”

**About Joe**

Worked on top designs of the time. His machines are known for smooth run and long life. Puts emphasis on accuracy and precision (hence the nick). Accepts new software slowly, but then is able to get the most of its features (⇒ numerous bug reports). Uses a high-performance FORTRAN library for dynamic balancing.

**Frustrations**

- As the engineer responsible for the final design, he is worried about the quality of computational analysis – the reputation of the team is at stake.
- Hates time pressure, but takes it as a challenge
- He needs to focus on design, and has to communicate with others effectively.

**Tasks**

- To decide on manufacturing technology used
- To integrate all parts of the design
- To coordinate his team’s work

**Goals**

- Insists on highest standards of engineering
- Wants flexibility and quick response to customers’ needs

# Building a persona

- As many sources as possible
- As reliable sources as possible (anecdotes e.g. from sales can be misleading)
- Cluster analysis: too many clusters – too many personae – loss of effectivity. **Primary** and **secondary** persona.
- A gap in the cluster analysis:
  - what is not our user
  - negative persona
- Based on anything we know – even an existing individual

# Cluster analysis

# Using personas

- **What-if:**
  - Father Pourwell, a retired fireman, hardly knows what the firewall does in his computer
  - If we don't provide Josh with a fast exploration ability, he'll kick us out
- **Scenarios:** The persona in action with the artifact, also as a sequence of pictures (storyboarding)
  - Josh explaining Joe a new kinematic diagram
- **Predictive methods:** users described by a personas
  - once as Josh, once as Joe
- **Web analysis:** data segmentation by personas
- **Usability testing:** participants selection
  - 5 exemplars of Josh, 5 exemplars of Joe (OMG!)

# COLLABORATION AND GROUP TECHNIQUES

# Roles of users in design

- “Liaison officer” – a representative of future users
- Domain experts
- Partners in discussions and decisions
- Testers, evaluators

# Collaborative design

- **Includes** and **uses** research, evaluation, brainstorming, discussion and other techniques
- Aims at **optimum combination** of the participants' abilities
- The crucial feature: **common decisions** (development orientation, features, sprint agenda)
- **Communication** by prototypes, real (partial) artifacts, easy-to-understand documents (personas, storyboards)

# Collaboration

- **The strengths** of the participants complement
  - users: practical processes, practical needs
  - designers: overview, technology, invention, systematic thinking
- Needed: **a small number** of **good people**
- Needed: **trust** (goodwill, integrity, ability):
  - to speak freely
  - to accept a leader, moderator
- Needed: An understanding of different work culture, work style
- The **starting point: a common goal** (concept, consensus)
- The **conclusion:** for all participants – what have we learned or decided

# Work ethics

- Ethics
  - a way to distinguish values considered good and bad by the society
  - non-ethical values: the need for food, shelter, acknowledgment, partner, …
- Partners have the right to decide for themselves ⇒ the right to
  - know whose responsibility it is
  - know whose profit it is
  - quit
- Ethical conflicts → ethical analysis
  - who is involved?
  - what ethical and non-ethical values are involved?
  - what is their hierarchy?

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# Understanding as a social tool

just a reminder

- A tool of change
  - whose profit?
- The observer as a link
  - between people and technology
  - so they shall act for the observed
  - which is difficult with all those mighty shareholders around

**THOU SHALL EXPLAIN
THY FINAL REPORT
TO THE PEOPLE
THOU HAVE OBSERVED**

# Creativity and problem solving

- A problem in design often contains a **contradiction**
- Contradictions can occur
  - in group collaborations
  - between stakeholders
- Contradictions can lead to **progress** or to **disruptions**
- A contradiction needs to be **researched, analyzed, solved**
- In a group setting, everyone should participate in the process
- A **culture of discussion** is required
  - a disagreement encourages creativity
  - a quarrel puts the participants into trenches

# Creativity and problem solving

- Contradiction **research**
  - what contradicts what (parameters, resources, …)
  - what positive values do the alternatives represent (readability, content richness)
  - what is the values to particular stakeholders
- Contradiction **analysis**
  - what is the root reason for the contradiction
- Contradiction **solution**
  - is there a solution which preserves all of the positive values?
  - can it be circumvented, compromised?
  - can it be resolved by generalization?
  - (and by several tens of other general techniques)
- Or to “sleep on it”: better to let more heads sleep on it

# Group techniques

- The principle
  - A group of **users** exchange information with a group of **designers**
  - The exchange is supported by a **moderator** (facilitator) – a person whose **sole interest** is to facilitate the exchange

# Group research

- Questions from the users
  - future design details
  - future social interactions
- Questions from the designers
  - domain expertise
  - current work process (informal procedures, ...)
  - attitudes
- Even incomplete and incoherent answers welcome

# Group evaluation

- **Informal**
  - Designers to users:
    - prototypes
    - mockups
    - ideas
  - Users to designers:
    - opinions
    - alerts (problematic aspects)
- **Formal**
  - pluralistic walkthrough
    - paper prototypes
    - controlled path discovery

# Brainstorming

- The principle
  - to familiarize the participants with the problem
  - to ask for ideas, to support them
  - to avoid any value judging
  - to maintain a relaxed atmosphere
  - to record everything (visibly – as starting points for others)
- The more people
  - the less ideas per person
  - and from circa eight people, the less total ideas

# Focus groups

- Possible purposes:
  - To discuss alternatives, ideas, options
  - To understand contradictions and differences
  - To complete missing knowledge and experience
  - To sort excessive number of ideas
- Preparation
  - 6 - 10 participants
  - Separate roles: moderator, requester, participants
  - Informative material
  - Selection style
    - homogeneous group
    - heterogeneous group
    - more groups

# Focus groups

- Activities
  - Wishes (3 per participant, free discussion)
  - Ideas (3 per participant, fixed order)
  - Evaluation (of demonstrated solutions)
  - Ask… (project manager, developers …)
- Execution
  - Introduction
    - goals, rules
    - instructing
  - Planned activities
    - wishes, evaluation, etc.
- Conclusion
  - Summing up the results for the participants

# Summary

- Research questions: the parts of context that do not come from information analysis – typically, the question of characteristic user groups
- Many techniques depending on
  - the kind of research questions – actions, attitudes
  - the kind of our user group – small and accessible or large
- Group techniques
  - users, designers, moderator
  - collaboration ethics, creativity, contradictions resolution
- Results projection – personas

# CONTEXT ANALYSIS

FIT ČVUT, KATEDRA ČÍSLICOVÉHO NÁVRHU

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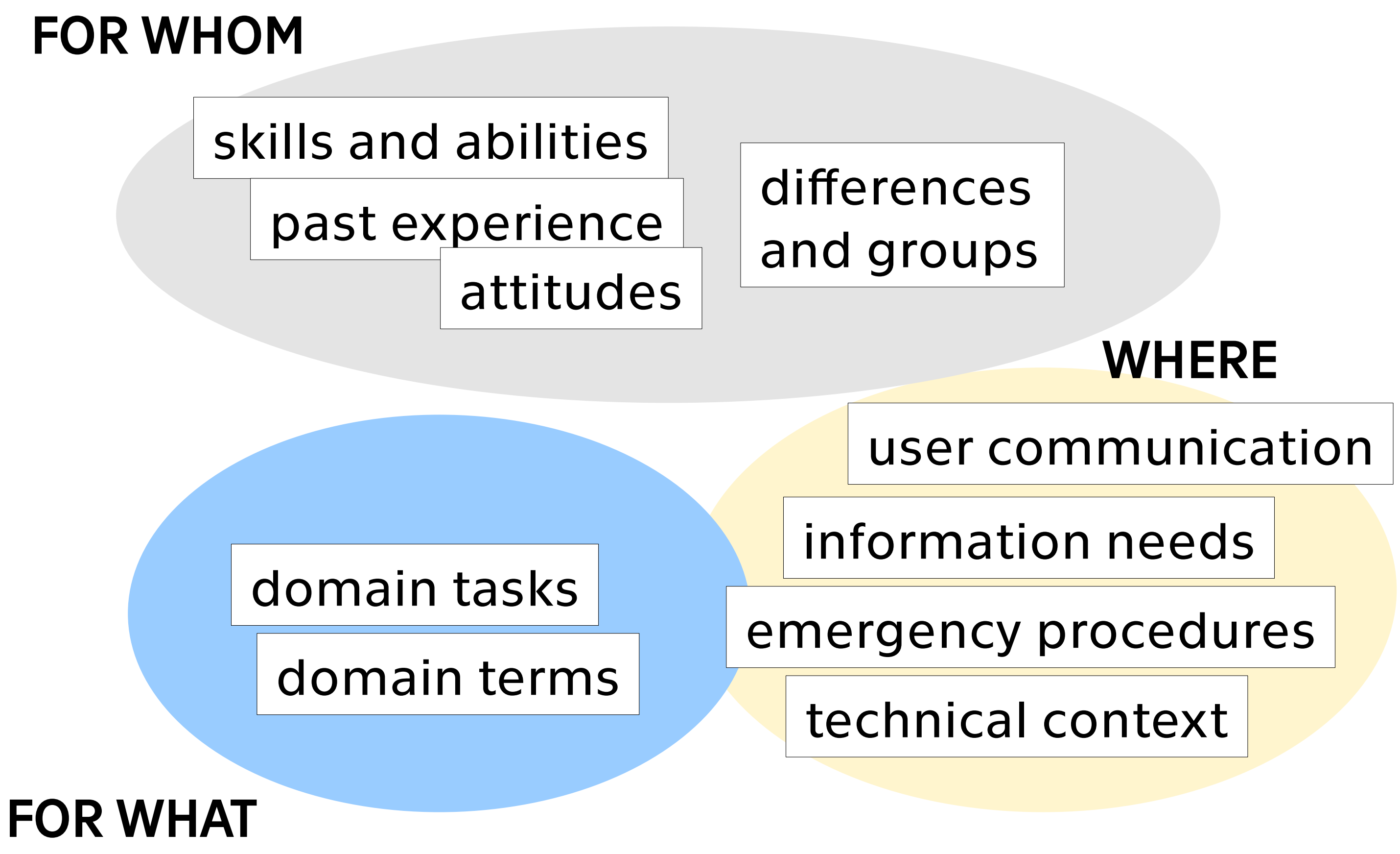
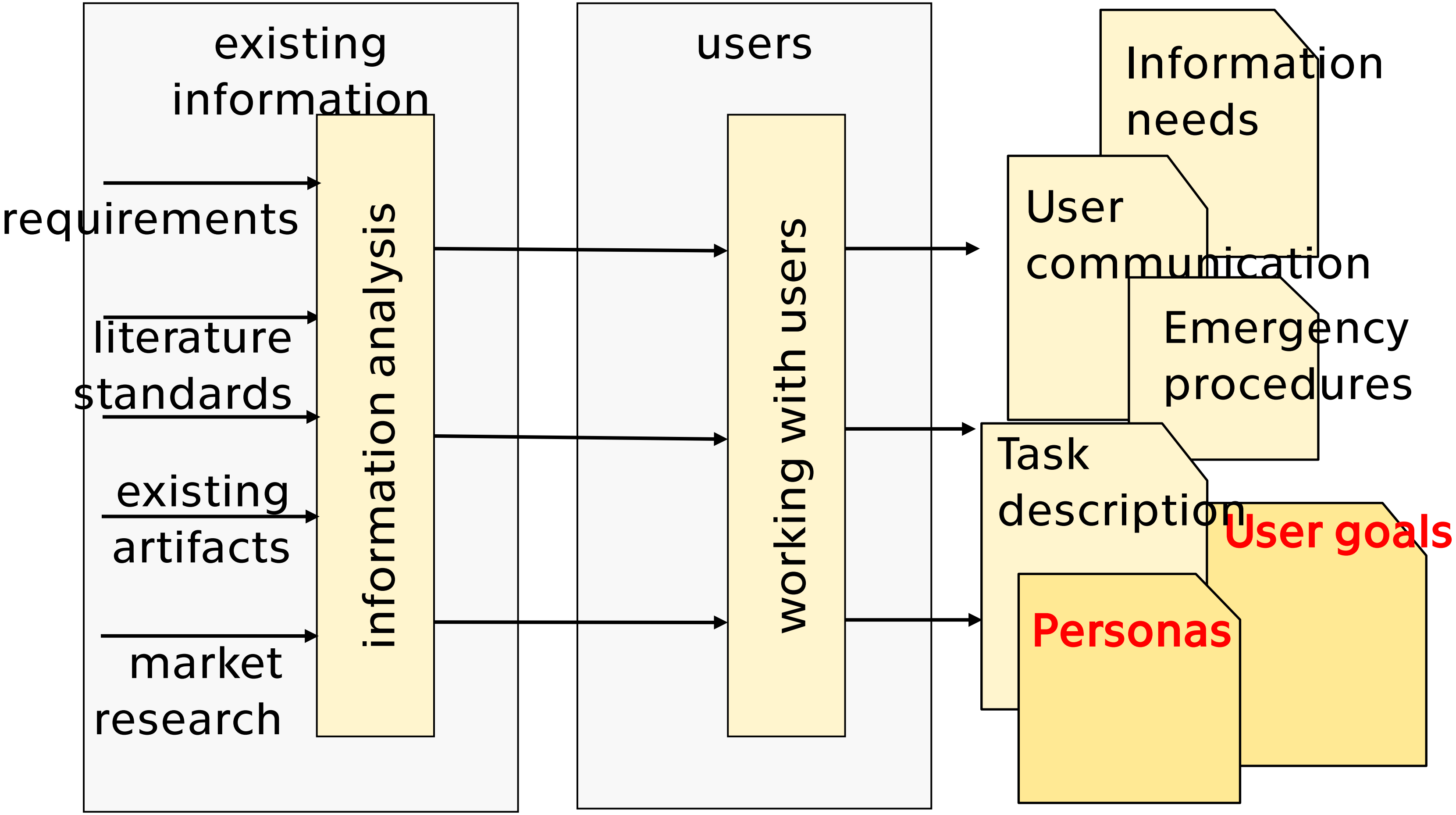
# Context analysis



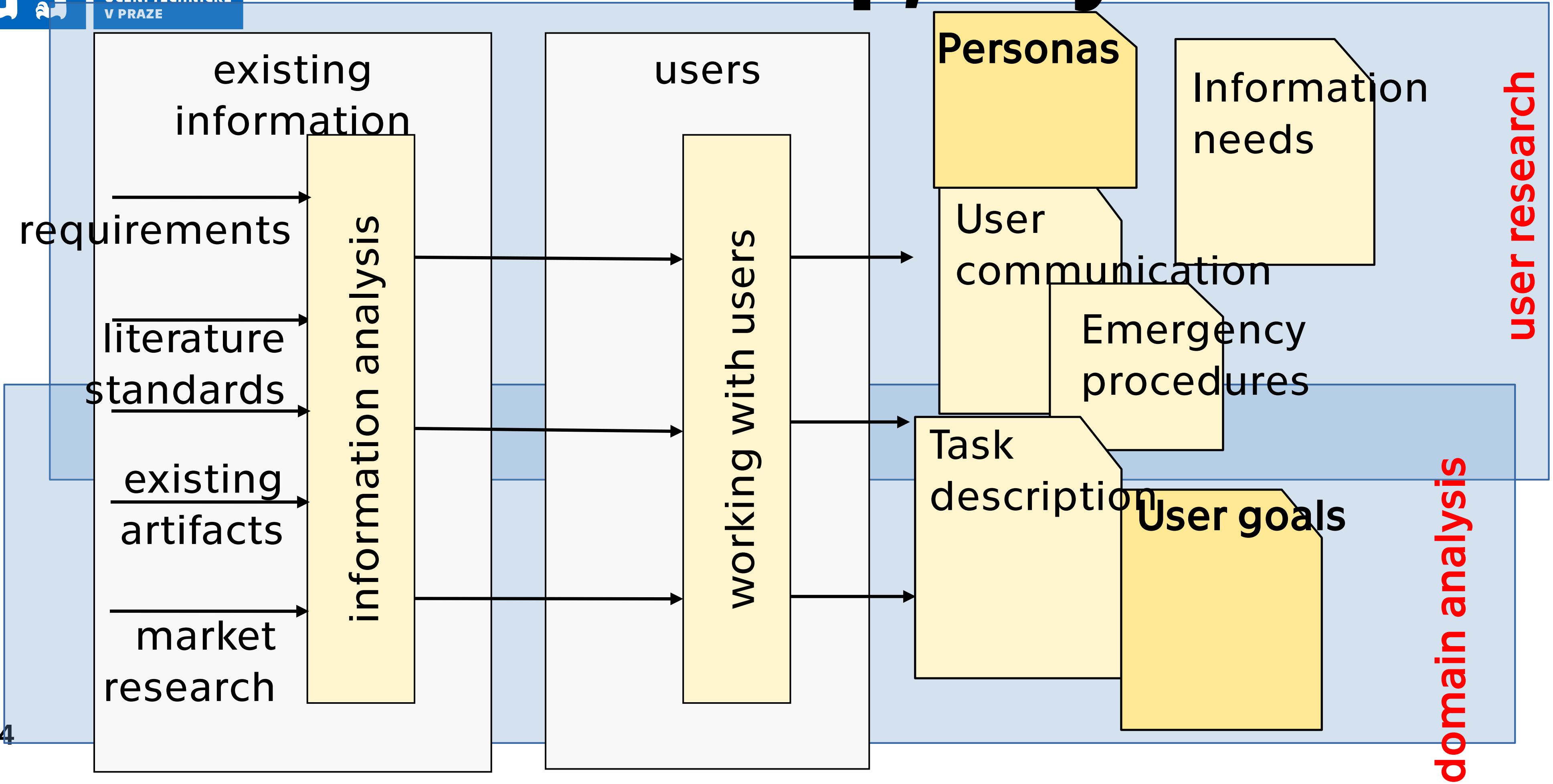
# Usability context

- Anything that directly or indirectly influences the use of an artifact
- Examples:
  - **who are the users**
  - **how do they communicate among themselves**
  - **what activity does the artifact support**
  - **what are accepted emergency/failure operations**
  - how frequently do the users interact with it
  - what is the environment
  - what other artifacts are used in connection

# Two phases


existing information
requirements
literature
standards
existing artifacts
market research
information analysis
users
working with users
Information needs
User communication
Emergency procedures
Task description
User goals
Personas

# Areas – overlap, may differ



# Relative "thickness"

- Systems for professional use
  - systematic use, training
  - domain terminology strictly required
  - complicated domains need domain analysis
  - information analysis **long and important**
- Systems for everyday life, for a variety of users
  - possibly casual use
  - domain evident
  - domain terminology known by everyone (or claimed to be known by everyone)
  - user work variable (secretarial, blogging…)
  - working with users **important**

# MODELS IN HCI

# Mental models


- I know it well
- I can perform mental experiments with it
- I can imagine it
  - clinking
  - bouncing
  - rolling
  - crashing
  - …
- **I have a mental model of it**

My favorite glass: special thanks to local IEEE Student Chapter

# Mental models life

- Emerging by work, experience, experiments
  - working with an artifact → a mental model of the artifact
  - studying a manual of an artifact → a mental model of the artifact
- Influence users′ work
  - „is this possible at all..?“
- Not transferable
  - only small part of it: language, art…
  - cf. evaluation: speaking aloud
- Specific
  - no two people have the same mental model

# Models in HCI

- User research: users' mental models of
  - domain
  - work process
  - social relationships
- HCI development: a team work
  - understanding = developing a mental model
  - multiple team members develop partial understanding
  - communicating that in a team?
  - developing a consensus?
  - → model externalization

# Externalization in life

- Is everywhere, everytime - only a fancy name for cognition and communication
- We interact – we
  - learn it
  - analyze it
  - understand it
- Afterwards, we
  - write a book (or a diploma thesis) about it
  - teach it
  - talk about it to a friend
- The receiving side of the communication incorporate it into their mental model (or not) – hence **in-formation**

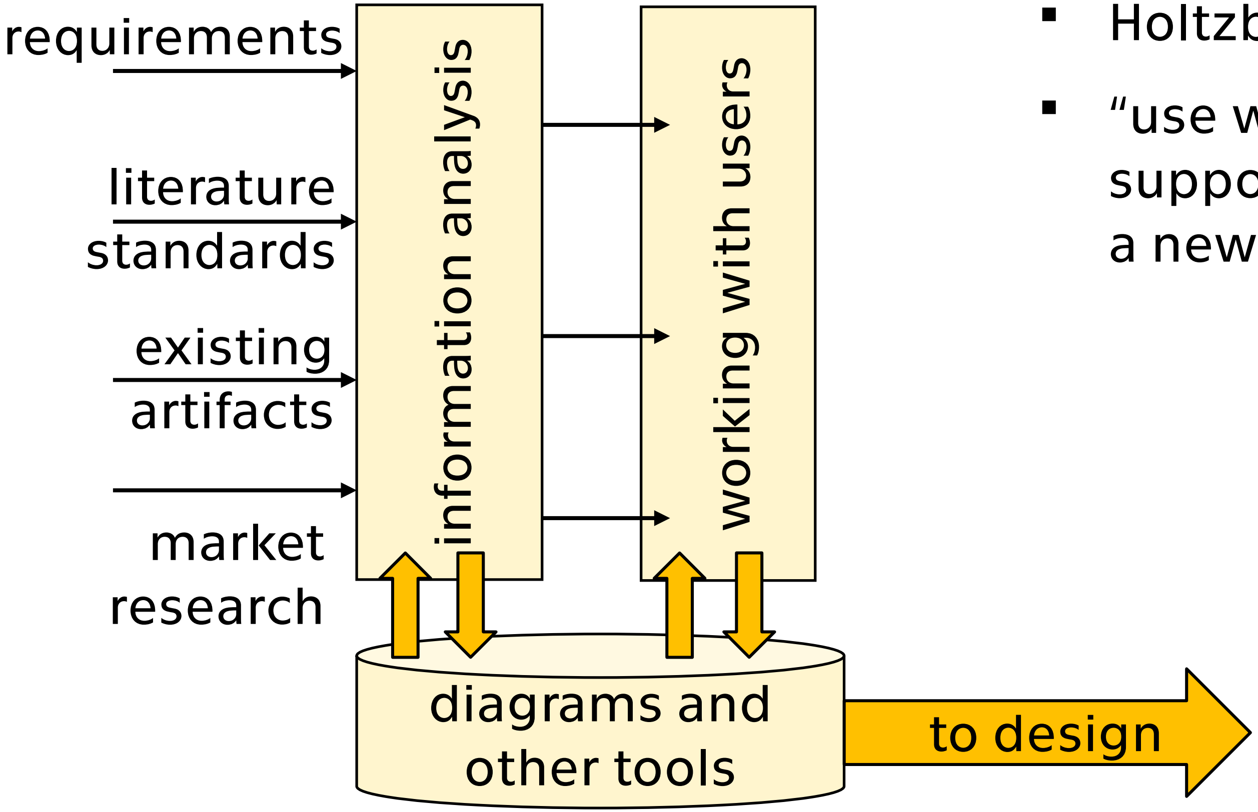
# Externalization as an opportunity

- … to **organize** one's mental model, to **clarify** it
- A clumsy model (vague definitions, important and unimportant terms or relations mixed up, etc.) results in
  - an incomprehensible explanation
  - a talk that does not achieve its aim
  - a bad artifact (cannot be understood)

# Externalized models in HCI

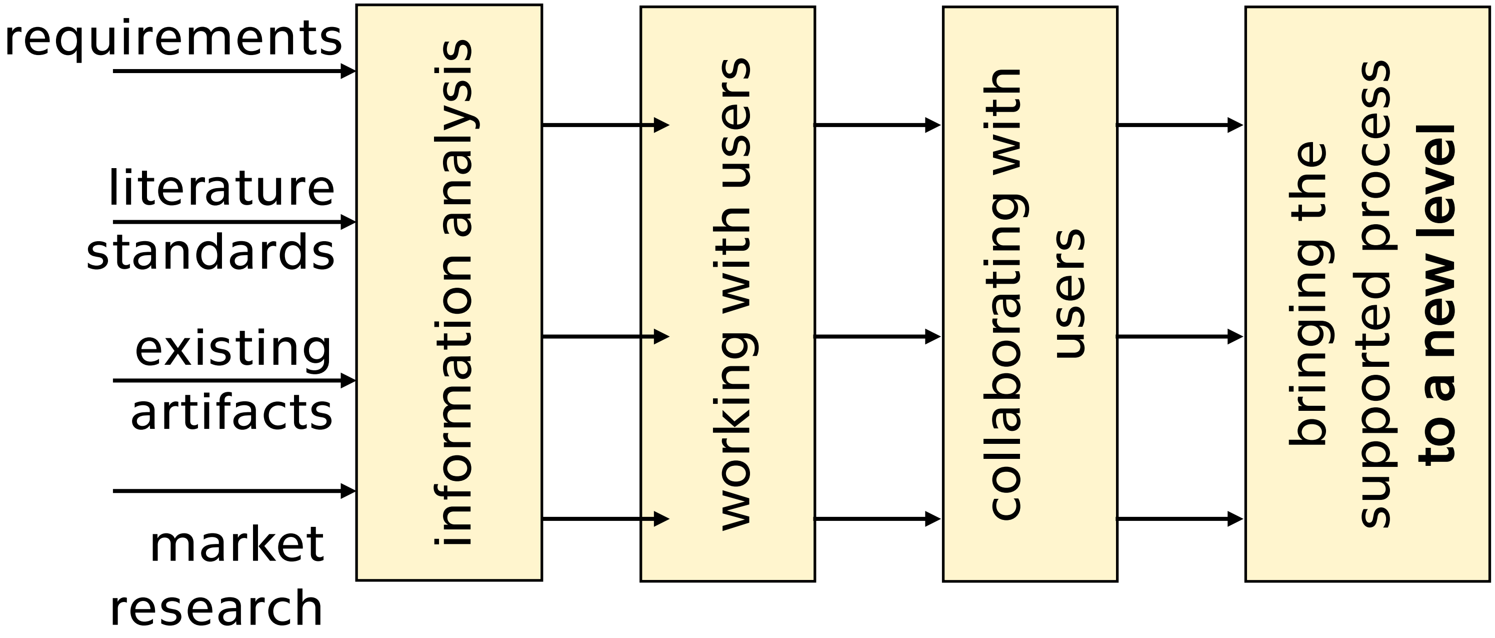
- Specialized “languages” to support talking about a specific subject
  - knowledge repository within a phase
  - knowledge representation resulting from a phase
- What should they be able to do
  - easy to learn
  - comprehensible even to collaborating users (where required)
  - support discussions
- What are they
  - ⇒not entirely formal
  - graphical – diagrams
  - textual – e.g. glossaries
  - dynamic – parts rearranged, grouped, labeled…

# Model-based context analysis




- Holtzblatt 1998
- “use whatever language supports your talk, or invent a new one”

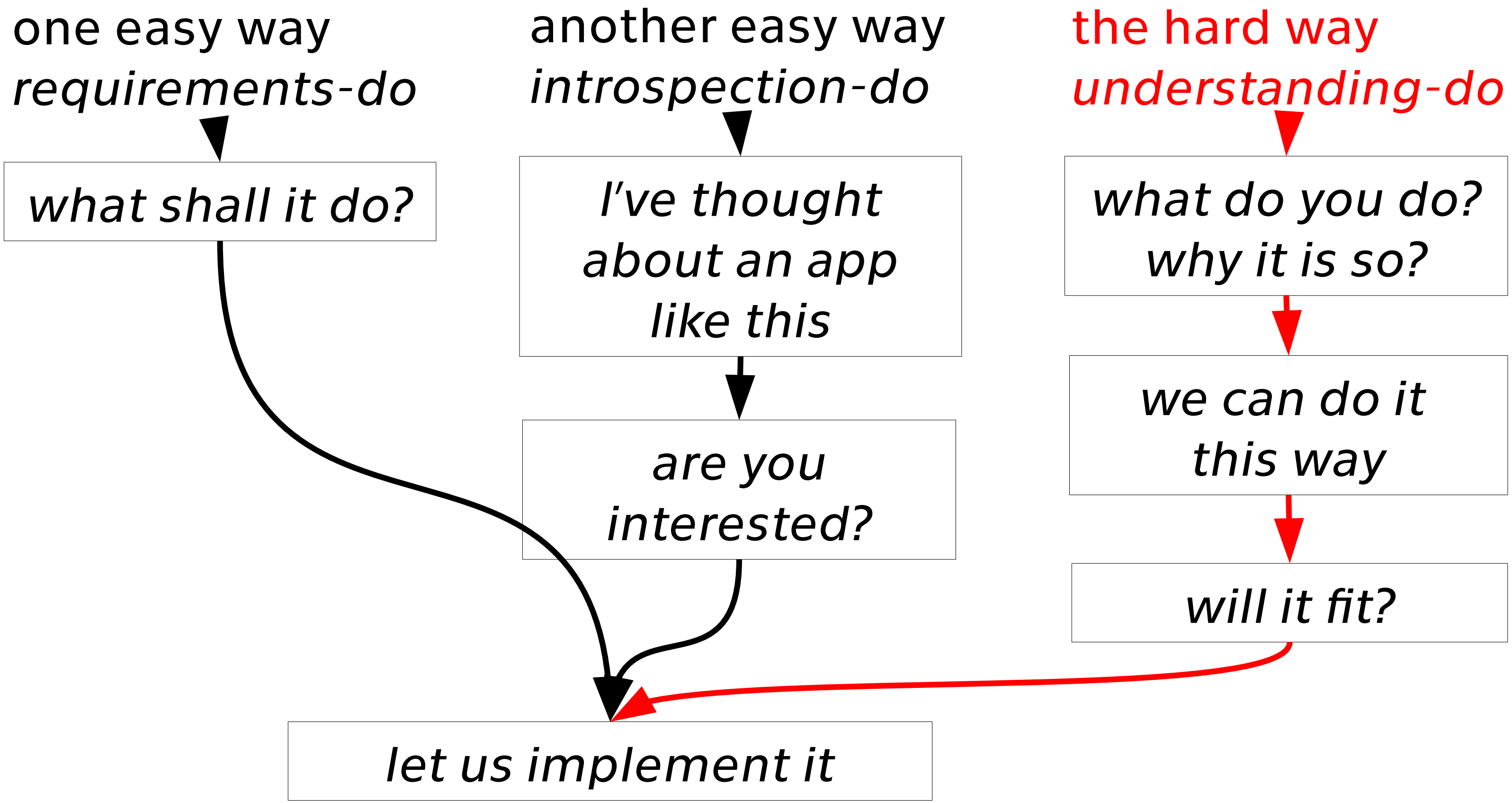
# Context analysis and innovation



# Why?

- Users are experts at what they **do**
- Users are not experts at **analyzing** what they do
- Users are not experts at what **can be done** for them

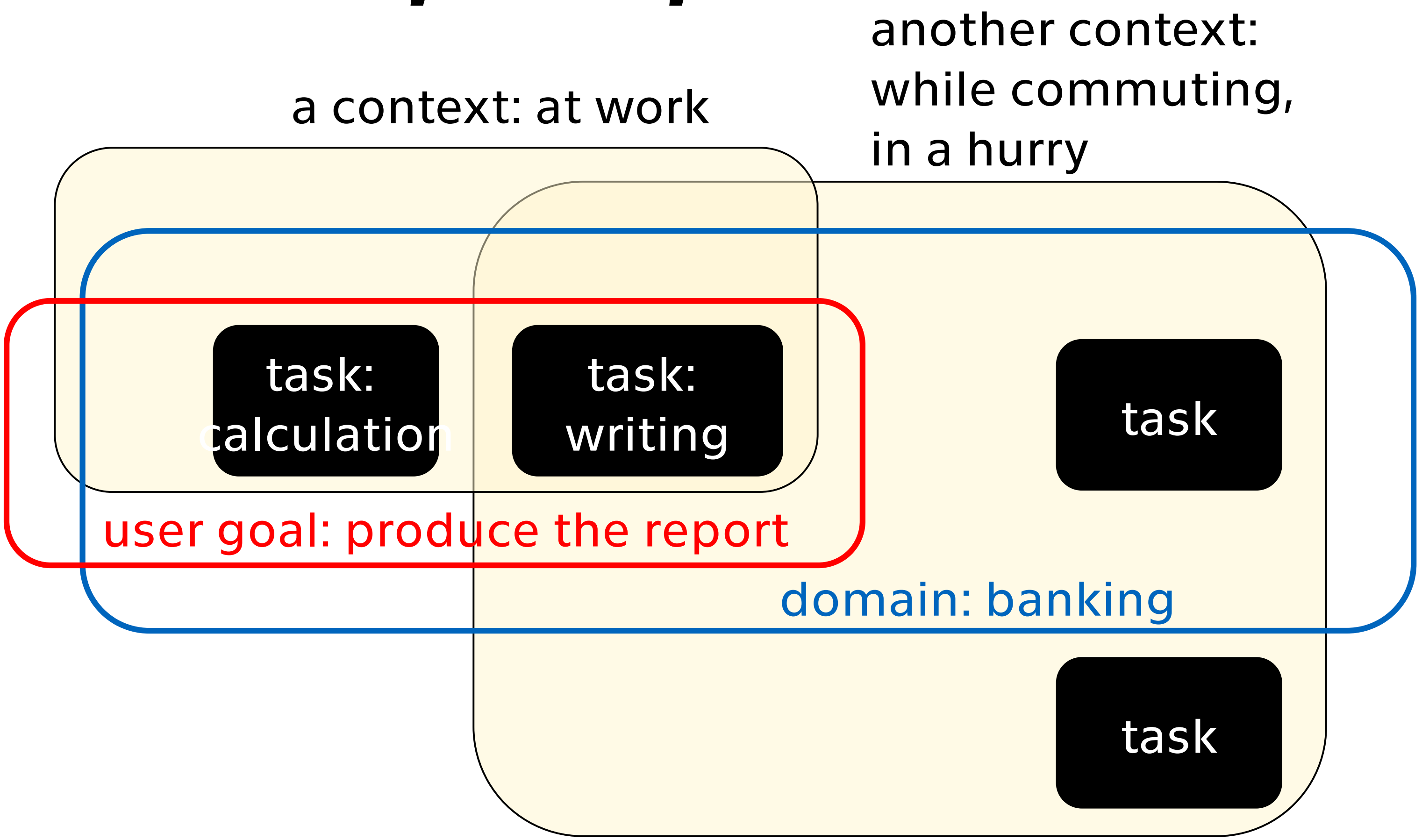
# How?



one easy way
requirements-do
what shall it do?
another easy way
introspection-do
I've thought about an app like this
are you interested?
the hard way
understanding-do
what do you do? why it is so?
we can do it this way
will it fit?
let us implement it

# INFORMATION ANALYSIS

# Context, task, domain



# Domain

- A determined area of human activity/knowledge
  - office work
  - steam engines design
- Determined by: what is equal and what is not
  - vertically; capacitors
  - horizontally: consumer electronics parts

# User goals and tasks

- A task: what shall be done with a single artifact
- A part (or the whole) of a **user goal**
- Still taken from the point of view of the user

- A task can have a hierarchical structure **if needed**
- Actions, operations, operation chains, procedures

# Information analysis workflow

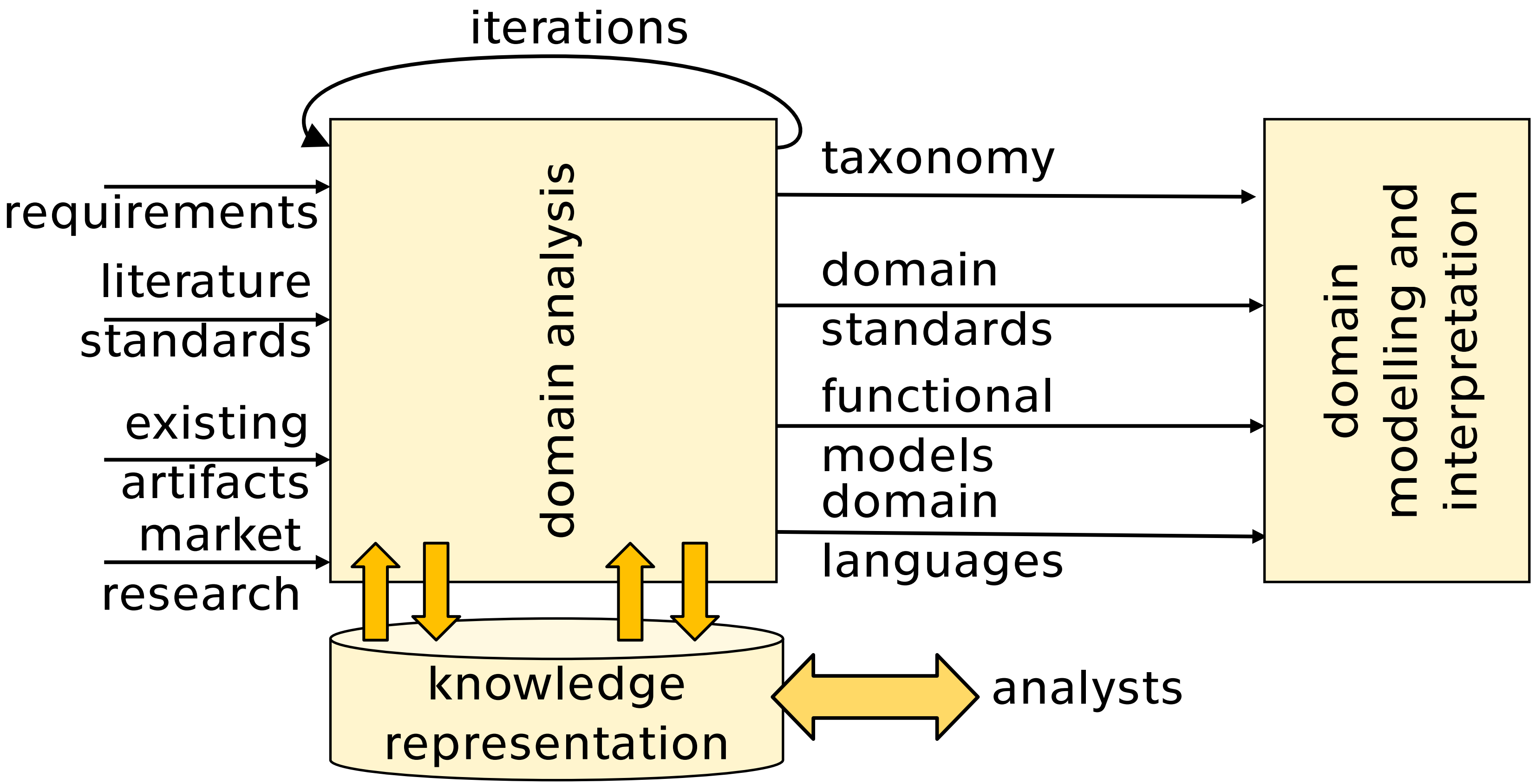
- All information sources are analyzed for **domain terms** and **domain relationship** between them
- Market analysis, existing artifacts, requirements:
  - **what terms do they use** – not e.g. a SWOT analysis
- Examples:
  - there is a market segment of **amateur/hobbyist** systems
    - → there are at least two groups of users
    - → their needs differ substantially
  - there is a requirement for fast **design space exploration**
    - → a new term for our glossary
    - → a need of the users

# Context and task description

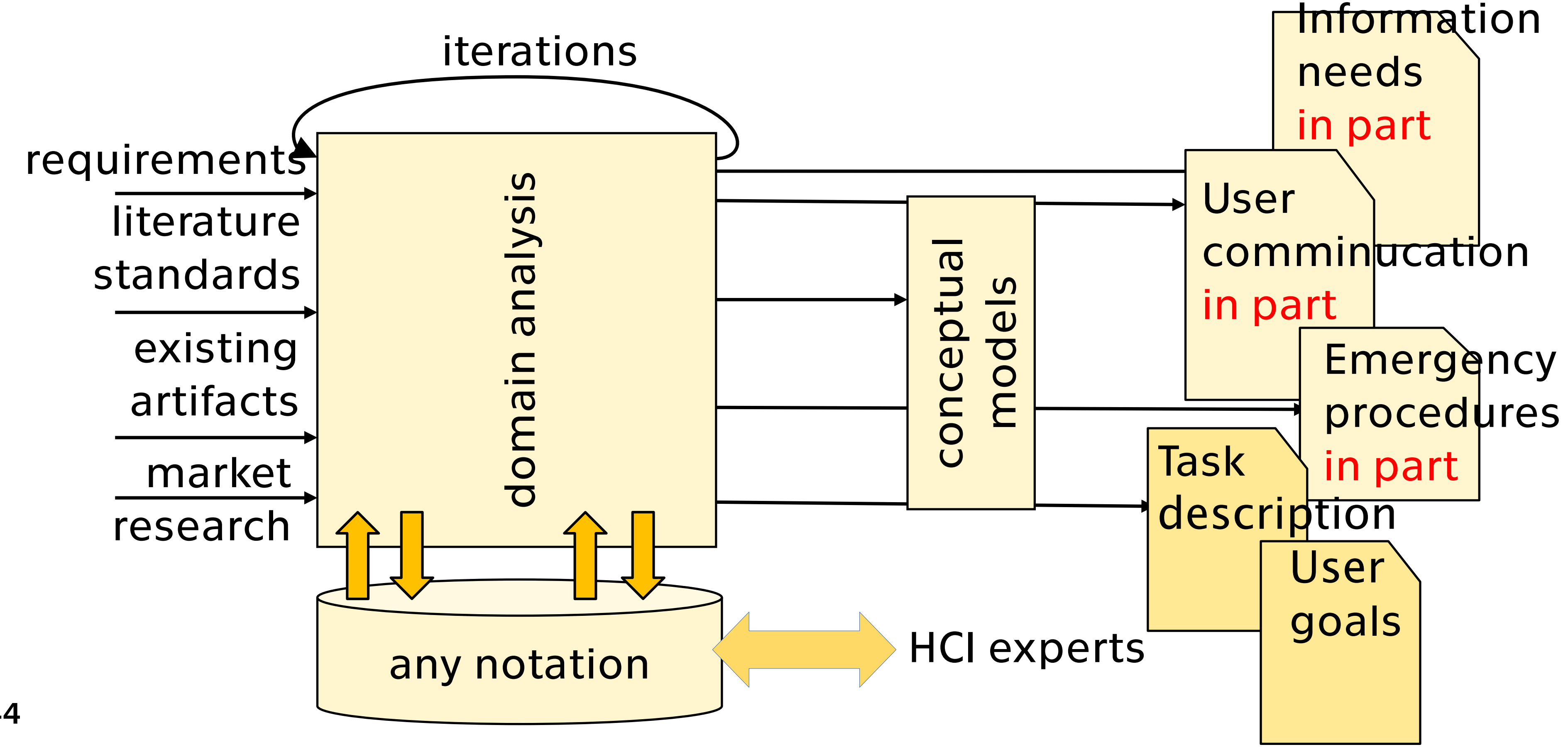
- Main analysis
  - user groups and differences
  - tasks, procedures, operations
  - information needs
  - existing processes and artifacts use
- Detailed analysis – when required
  - task structure, operation chains
  - individual differences

# Domain analysis

## in software engineering



# Domain analysis in HCI



# HCI domain analysis output

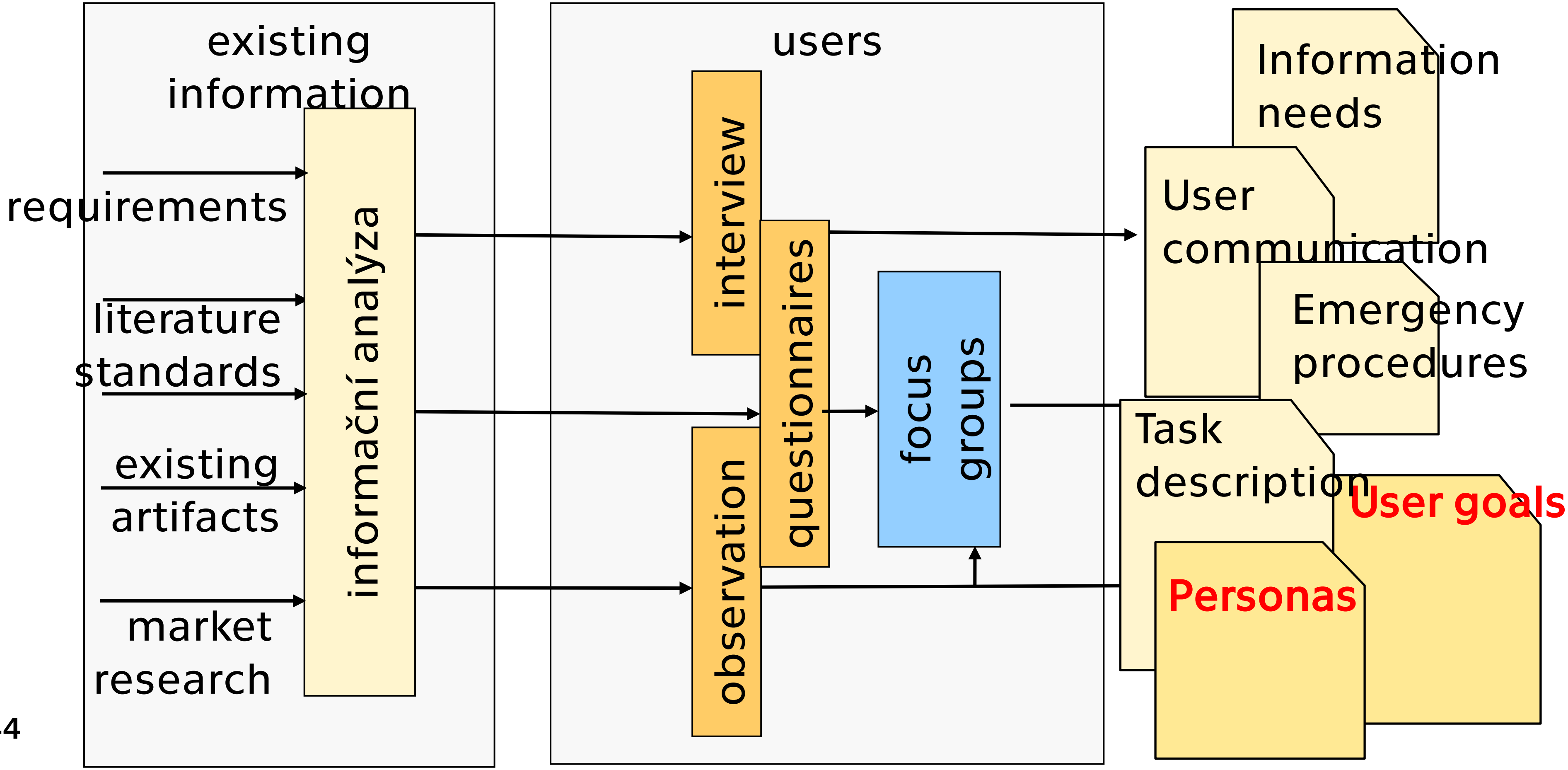
- Contains
  - Domain terms and relations
  - Domain tasks
- Intended to be
  - A part of context description
  - Used by designers not automated tools
  - Easy to use and expressive
  - Not a formal ontology

# ANALYSIS WITH USERS

# What do we need to learn

- What cannot be in the information analysis
  - Skills, attitudes and other material for personae
  - How the users communicate
  - Irregular procedures
  - Information for decisions
- What is in the information analysis, but we need to confirm
  - real procedures
  - real communications
- What is hard to understand in the information analysis
  - Relative importance of various facts
  - Simple explanations of complex terms

# The user phase

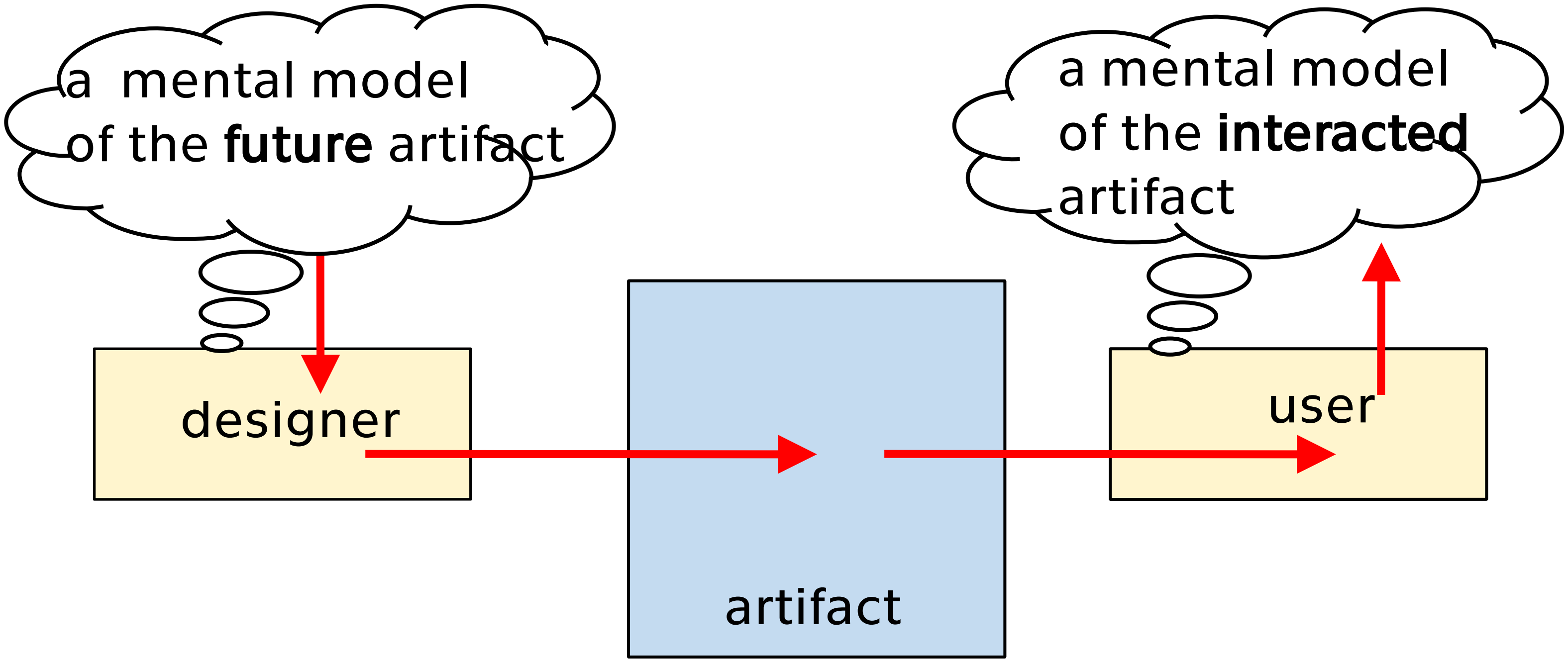


# Methods

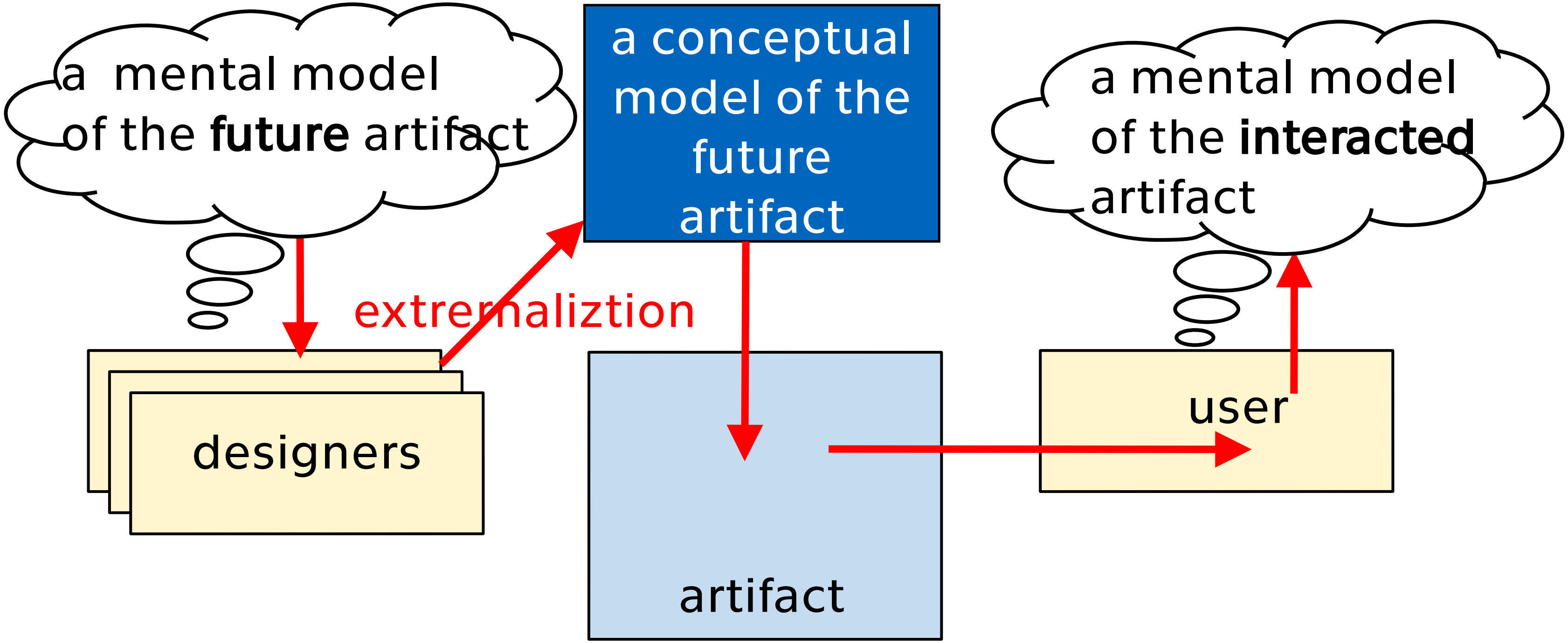
- Preliminaries:
  - „the homework“ (information analysis) done
  - know what is needed
- Depend on **what we want to know**
  - **simple** question, broad target → questionnaires
  - **deeper** understanding, non-standard procedures → (informal) interview
  - **attitude**, opinions → focus groups
  - **activities** → communication in a real situation → (participating) observation

# CONCEPTUAL MODELING IN HCI

# Mental models and artifacts



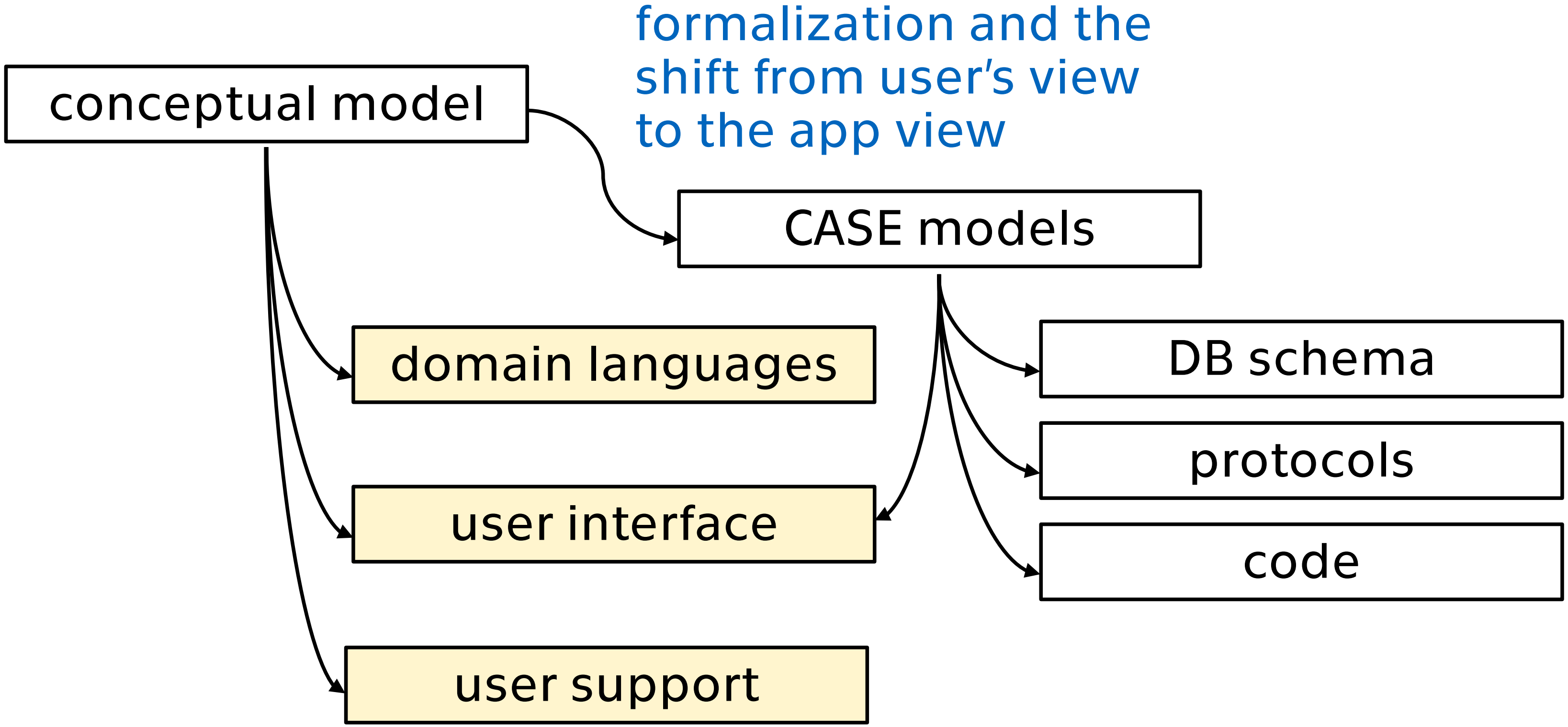
# Model externalization



# Conceptual models in HCI

- **Moving** from user **activities** to **artifact design**
  - domain terms and relations
  - domain tasks
  - information presentation
- **Targeting**
  - designers
  - documentation
- **Creating**
  - mostly, natural language description
  - term glossaries, dictionaries
  - formal models e.g. in OntoUML - possibly

# Using conceptual models



# CLASSIFYING ARTIFACTS BY THE DOMAIN OF THEIR TERMS

## HOW THE ARTIFACT'S TERMS RELATE TO THE TERMS IN REALITY

# An artifact as a description

- **The reality:** a mechanism
  - 3D space
  - a wheel
  - an axle
  - a bearing
- **The artifact:** a mechanized drawing board
  - 2D space
  - a view
  - a line
  - a circle
  - a dimension line

- Mechanical drawings evolved as a **graphical language** during a long time
- A drawing **describes** a mechanism
- The artifact uses terms of the description

# An artifact as a first-person experience

- **The (fictious) reality:** a war
  - 3D space -------------------------- 
  - a weapon --------------------------
  - an enemy --------------------------
  - ?? --------------------------
- **The artifact:** a game
  - 3D space in perspective
  - a weapon
  - an enemy
  - save/load

The artifact **uses**

- terms from a real domain
- terms of computer usage

The interaction is by **direct manipulation**

# An artifact as a tool

- **The reality:** an abstract electronic circuit, hierarchical, unrelated to 3D space
  - a gate ---------------------------
  - remove ---------------------------
  - run ---------------------------
- **The artifact:** an Electronic Design Automation tool
  - a gate
  - Edit →Delete
  - Tools →Simulate

The artifact **uses**

- terms from a real domain
- special terms denoting **tools for information manipulations**
- terms of computer usage

The interaction is by **indirect manipulation**

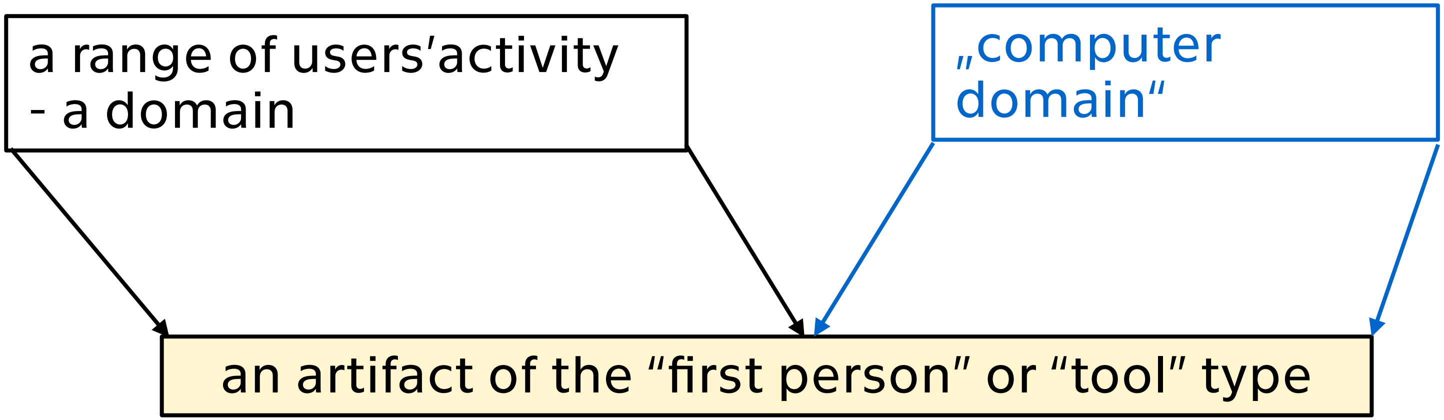
# An artifact as implementation

- **The reality:** business papers
  - business documentation
  - orders
  - invoices
  - new invoices
- **The artifact:** office furniture or a file system
  - the middle metal cabinet over there
  - the upper drawer
  - the drawer below
  - the first folder there

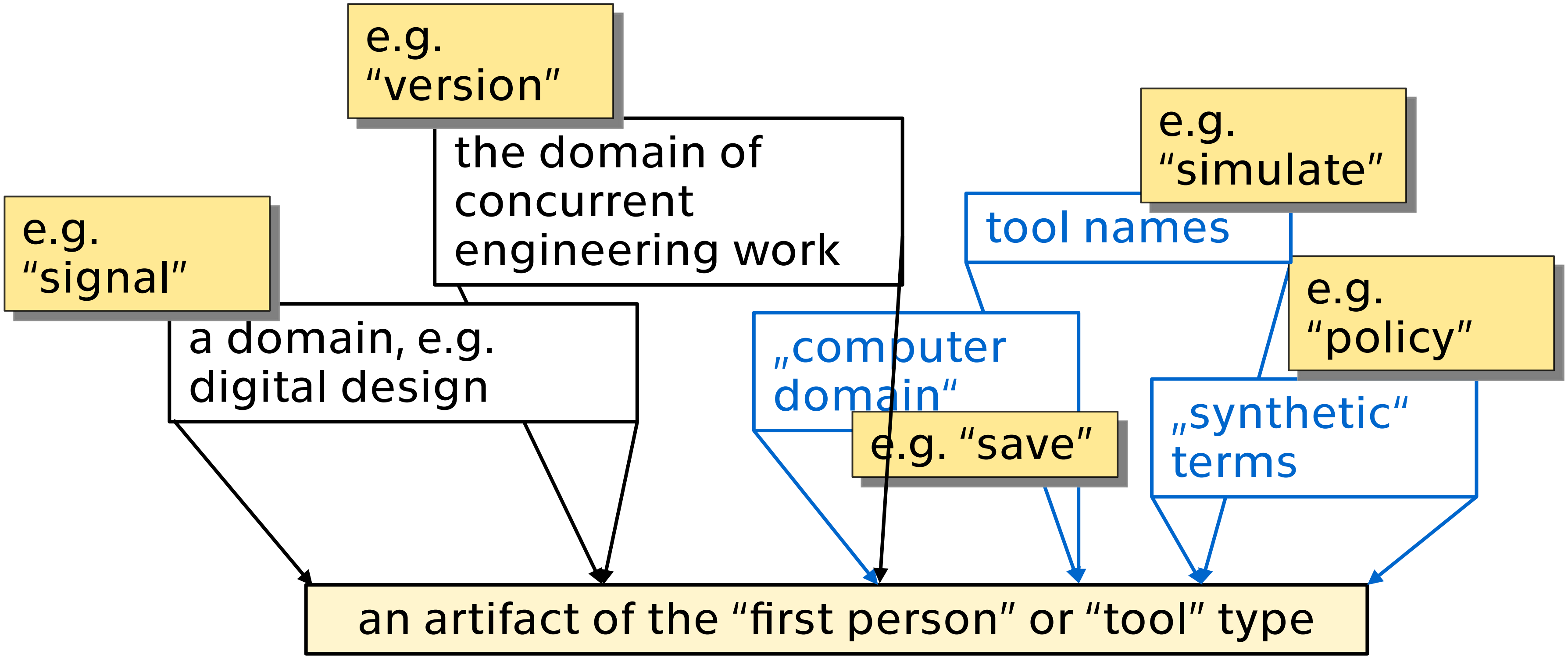
clerk-specific

- The artifact **implements** domain terms
- The correspondence is in user's **mental model only**

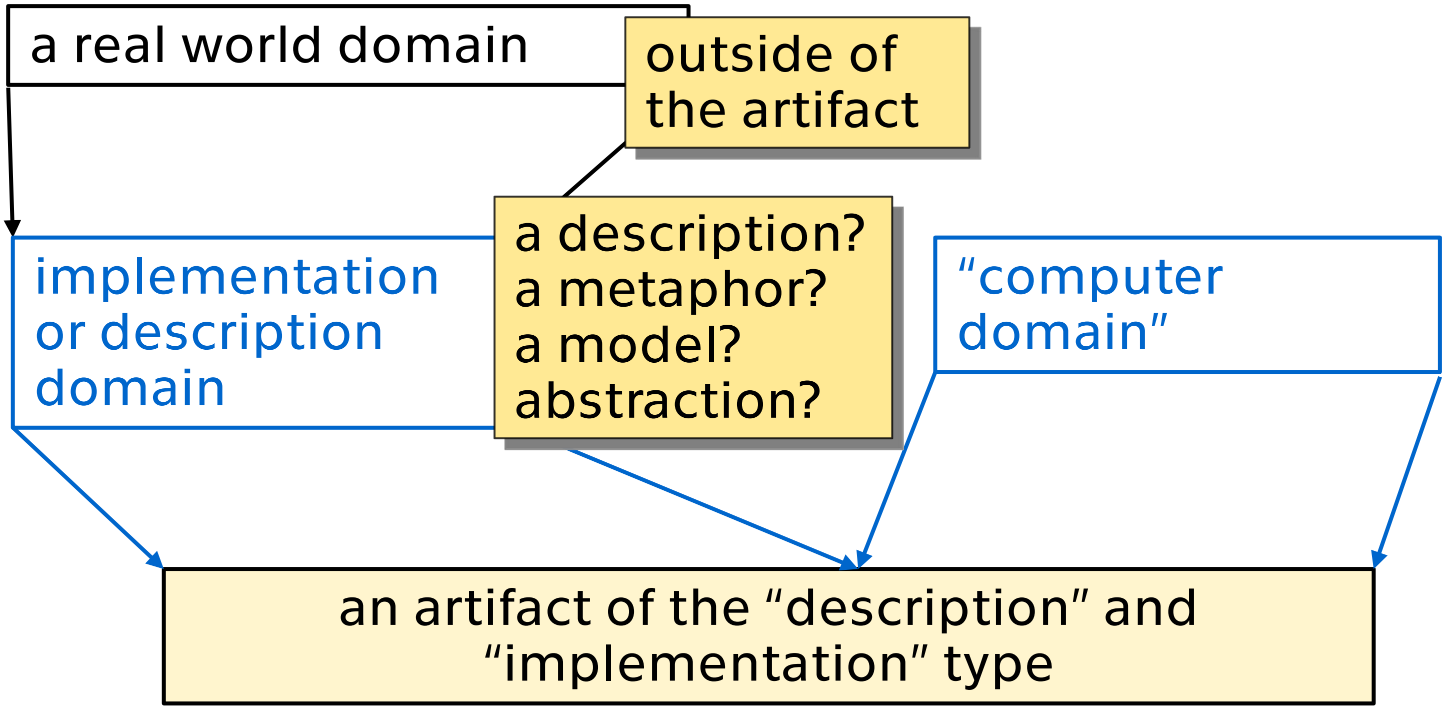
# Sources of terms in an artifact



# Sources of terms in an artifact



# Sources of terms in an artifact



# Summary

- Context and task analysis
  - everything that influences artifact's usage
  - two phases: information analysis, user research
  - supported by various models
- Information analysis
  - input: all available and existing information
  - domain analysis – terms, relations of a given range of activity
  - modeling, conceptual models
- User research
  - abilities, skills, preferences – possible differences
  - procedures, informal and emergency activities

ČVUT

ČESKÉ VYSOKÉ UČENÍ TECHNICKÉ V PRAZE

# INTERFACE DESIGN: INFORMATION ARCHITECTURE

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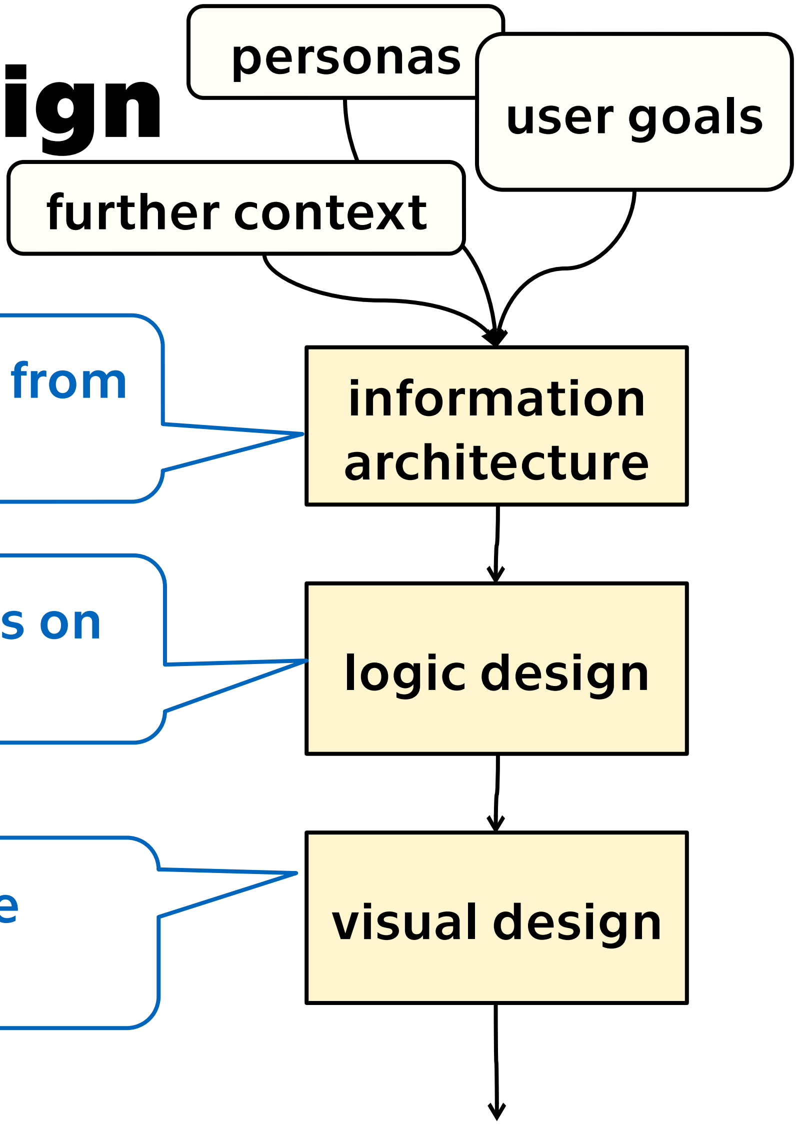
- DESIGN WORKFLOW
- INFORMATION ARCHITECTURE
- INTERACTION STYLES
- MOCKUPS FOR INFORMATION ARCHITECTURE

# Interface design

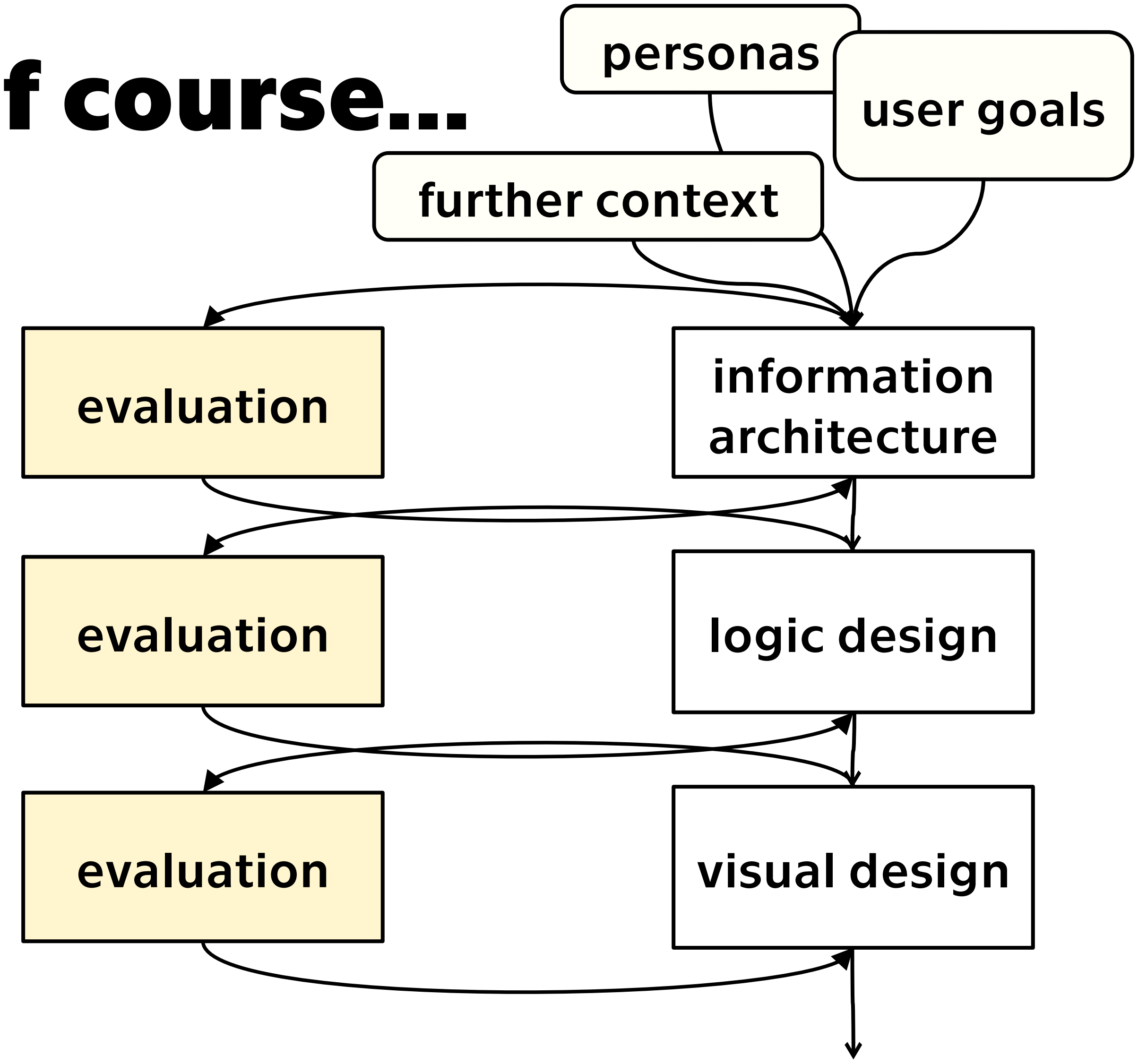



How to represent information – to and from the user

What information and control elements on a page – what is their hierarchy

Visual presentation of the logic and the hierarchy, visual focus guiding

# But of course...



# INFORMATION ARCHITECTURE

# Information architecture

- By what parts, in which relations, in which form is the information **presented to the user**
- Interactive systems: By what parts, in which relations, in which form **does the user present the information**
- Related term: information design

# Information architecture

- Comprises e.g.
  - the way to present database information
  - navigation principles
  - interaction styles
- Follows from user goals
- Depends on quantitative parameters – how many items or columns in a table, etc.

# The building stones

- The way to **present** information
  - How to satisfy information needs
  - How to access the information (by names, …) esp. in indirect interaction
- The way to **navigate**
  - How to structure navigation means
  - What information to use for navigation (which is mostly indirect navigation)
- The way to **interact** (interaction style)
  - Direct or indirect – most real artifacts are a mix of both
  - Stateful (modal) or stateless

# An E-shop information architecture

- Usual access path
  - From the main page
  - From other sites (comparators)
- Organization
  - Single hierarchy or multiple
  - Which attributes first
- Presentation
  - Tabelar
  - Pictorial
- Search
  - Which attributes
  - Filters (with states) or no

- User goals:
  - aims at a store
  - aims at some goods

- User goals:
  - how do they shop?
- Persona
  - goal-oriented customer
  - intuitive customer

# Systematic construction of information architecture

- Starting with **user goals**
- Decomposing to **activities**
  - Locating common activities of multiple goals (by their meaning, not by superficial similarities)
  - Constructing sequences for all goals
- Unifying activities to bigger units → **transition graphs**
- Implementing activities and transitions using standard means that is, Human Interface Guidelines

# Granularity of activities

- Many small activities,  to be combined freely
  - Supports creative use
  - Possibly „future resistant“
  - Needs more activities for common goals
  - Like a Lego set
- A few bigger activities aimed at common goals
  - Fast interaction
  - Limited by goals known in design time
  - Like accounting software with built-in current regulations

# INTERACTION STYLES

# Interaction styles

**1D**
in time or space

command
languages
natural language

**recall**

dimension

direct
identification

**2D**

direct
manipulation

**recognition**

visibility

indirect
identification,
navigation

indirect manipulation
menus, dialogues

# Interaction style: text

- Independent of visibility
- Can work with large sets
- Specification by procedure or algorithm
- = intension

- Based on recall
- Preserves interaction history, not present state

- „*.cc" is an **intension** of „all C++ source files" (concise)
- A list of concrete files is an **extension** of „all C++ source files" (possibly huge)

# Interaction style: direct manipulation

- Based on direct analogy with (2D,3D) reality
  - what makes sense from the user's point of view, is displayed
  - what has a shape in reality, is displayed that way
  - what can be manipulated in reality, is manipulated that way in the app
  - but additionally: save, load, …
- Usability problems
  - what can be manipulated here?
  - how do I manipulate this world? does d'n'd work here? → **affordances** (visual clues how to manipulate an object)

# Interaction style: model and tool

- Have a **model** of reality (not necessarily related to space – e.g. abstract schematic)
  - the user understand it because she/he is a domain expert
  - the artifact understands it because we've done domain analysis
  - „tool" is a frequent notion
- Some terms have to be **invented** (policy)
  - and does it pay to the user, to understand them?
- Manipulation feedback:
  - results shall be immediately visible
  - but sometimes require lengthy analysis (what will the bridge do when I remove that strut…)

# Reaction times in a dialogue

- Real communication environment: noticeable **latency**
- Reaction time is a **feedback**
  - „Normal“ reaction time, learned
  - Shorter: command ignored, failed, …
  - Longer: no feedback, unknown system state (crash, cycling…)
- Lazy system ⇒ lazy user (measured!)
- The **granularity** of a dialogue
  - Less information in one „turnaround“ of the loop: slow work
  - Much information in one „turnaround“: faster, but feedback more scarce, possible information loss in case of error

# State (of a system)

- A fundamental notion in systems theory, cybernetics, control theory, circuit theory – luckily, used consistently
- Our artifact **as a black box**
- Reacts **differently** at the **same stimulus**
- The information that determines the response: **state**
- The state can be
  - discrete (automatons, state machines, algorithms)
  - continuous (kinetic energy, capacitor charge)
- The state can be but needs not to be
  - **observable** (visible, measurable)
  - **controllable**

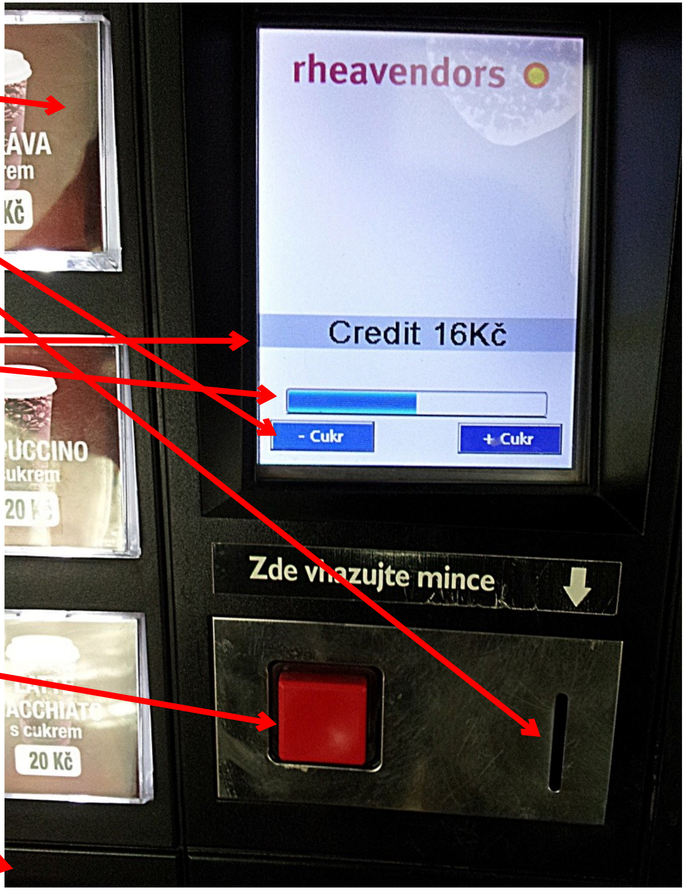
# System, state, response

system input

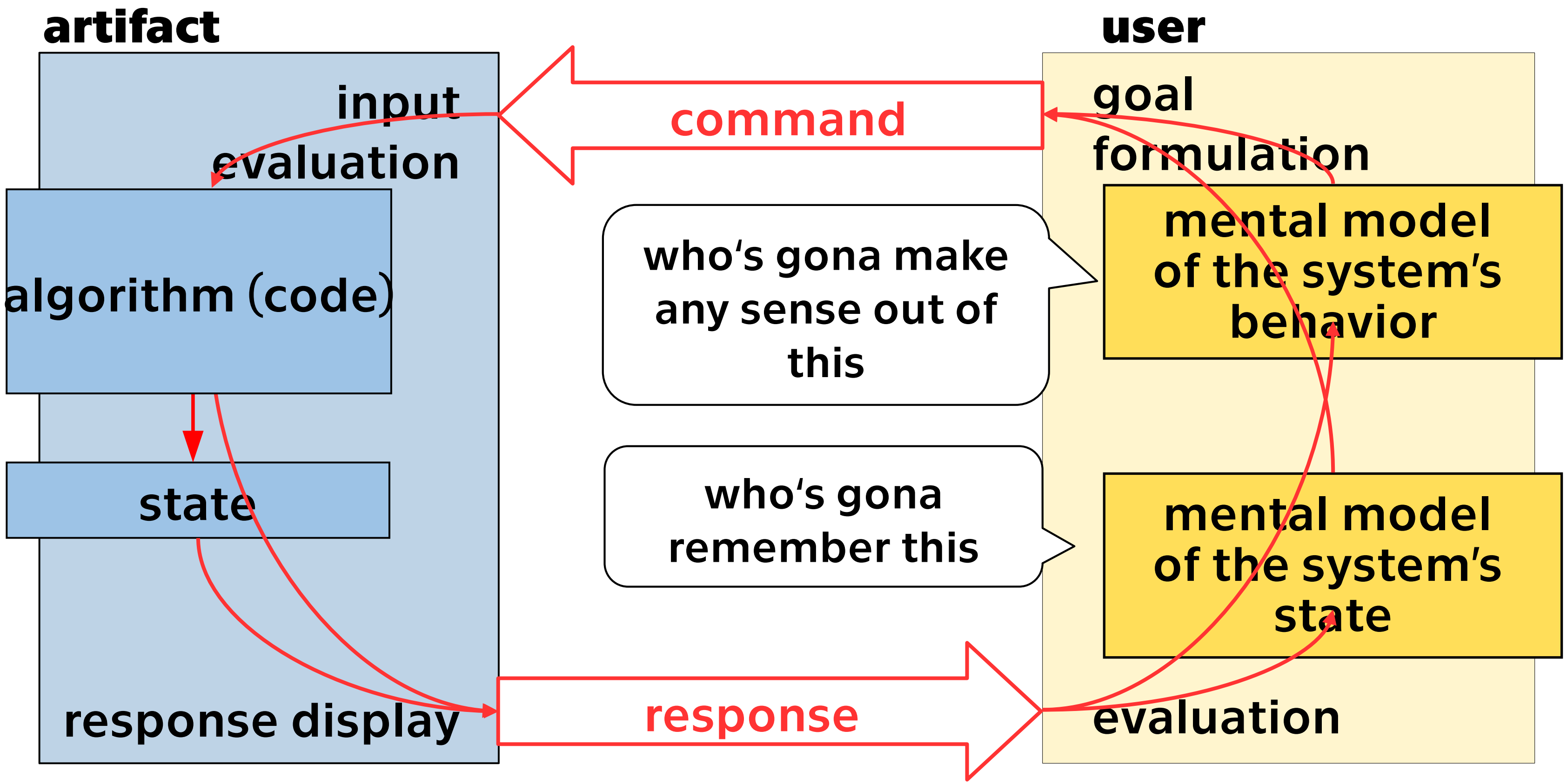
state visibility
to predict response
and enable control

emergency state control

system response



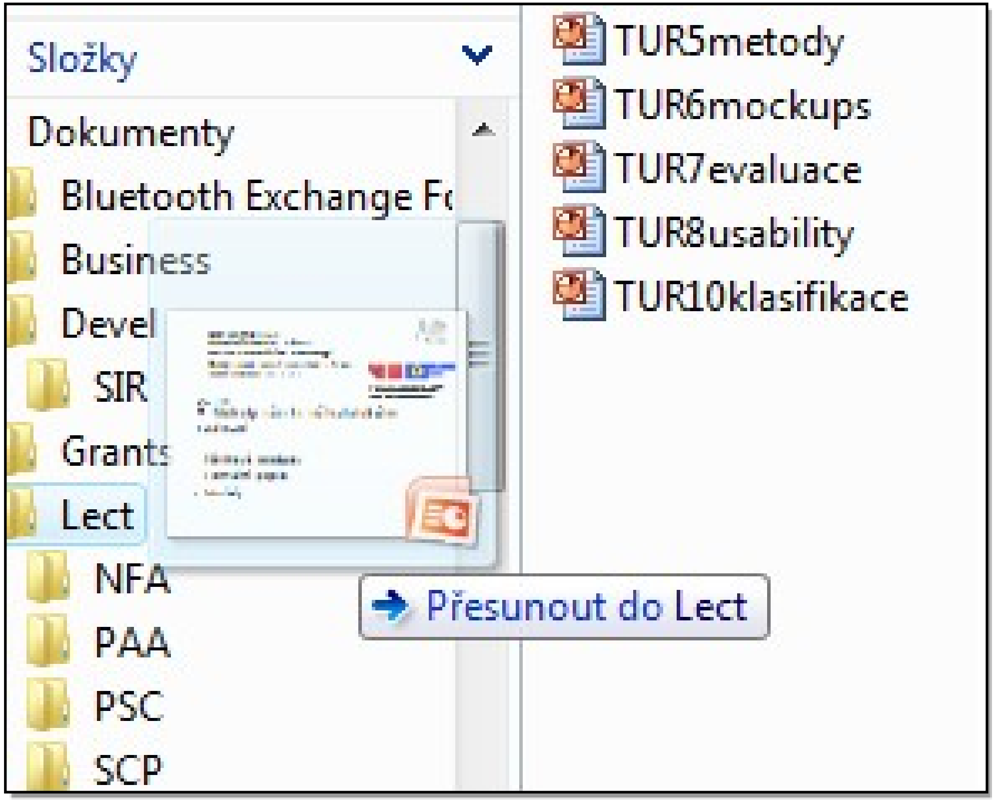
# Interaction as a closed loop



# Text interaction and its state

```
schmidt@pc-105:~> abc
UC Berkeley, ABC 1.01 (compiled Aug 31 2010 17:55:19)
abc 01> read devel/t481.blif
abc 02> print_stats
t481: i/o=16/1 lat=0 nd=2072 edge=6823 cube=4414 lev=10
abc 02> print_auto
This command works only for AIGs (run "strash").
abc 02> strash
abc 03> print_auto
Output #  0: Inputs = 16. AutoK =  0.
The cumulative statistics for all outputs:
Ins= 16 InMax= 16   Outs=  1 Auto=  0   SumK=  0 KMax= 0
Supp=  0   Time=0.00
abc 03>
```

# Direct manipulation and its state



# State and modality

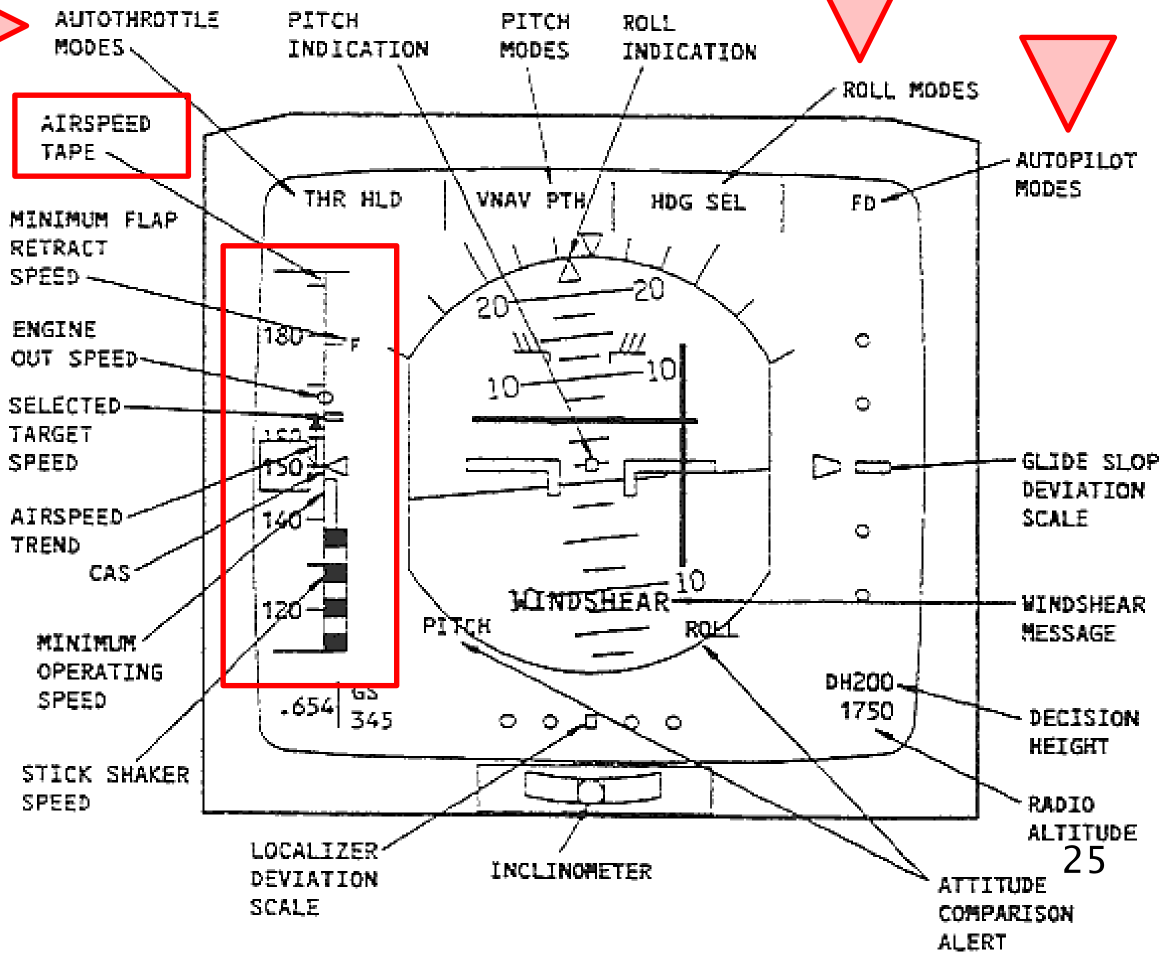
- The state of an artifact:
  - when both parties know the state, less talking
  - memory and cognitive load (where I am? How do I get there?)
  - the example above: the state is in app data!
  - state visibility as a mean to unburden the user
  - **does the memory and cognitive load pay for the user?**
- Modality and interaction
  - a simple set of states
  - state visibility
  - an example: drawing tools – tool selection

# Modal avionics

mode: hold heading (course)

# Modal avionics

**Boeing EADI**

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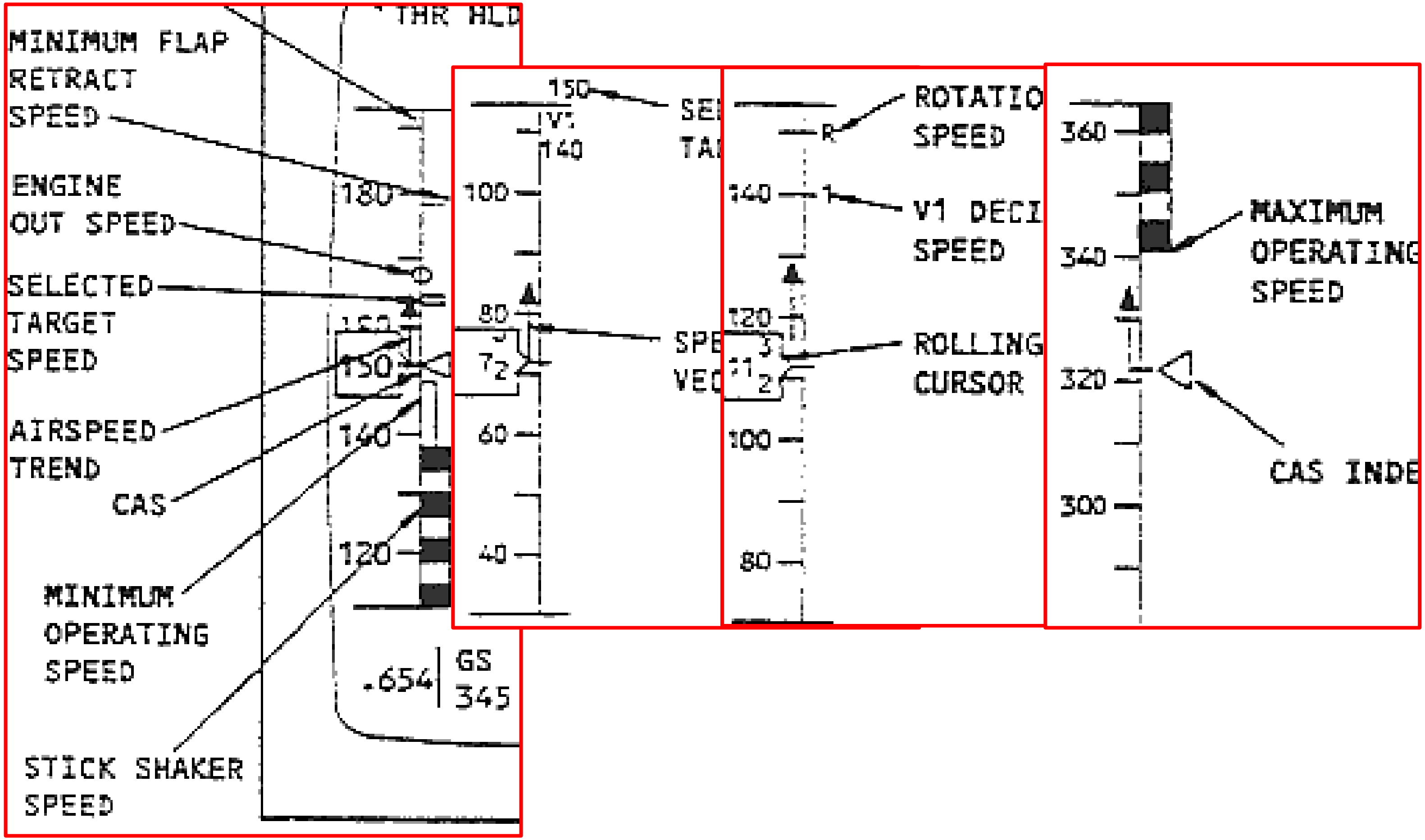
# Alternative display elements



# Mental models must be simple

- San Francisco on Jul 6th 2013, a Boeing 777-200, flight OZ-214 landing in clear weather
- … the auto throttle control shall prevent the plane from going too slow…
- **… except in the HOLD mode**


http://www.avherald.com/h?article=464ef64f&opt=0

# PROTYPES OF INFORMATION ARCHITECTURE

# Prototyping is communication

- Communicate the current state of the design
  - To make opinions
  - To evaluate
  - To improve
  - Finally, to discard (**working material only**)
- **Communicate to**
  - UX team members (knowing UX jargon, diagrams…)
  - Our collaborating users (knowing little about UX, a lot about their work)
  - Our customers
  - **… as all those must understand it**

# Sequence sketches

- Graphs of sequences, merged into a transition graph or **interaction diagram**
- An interaction diagram is
  - easy to oversee (more goals at a glance), but
  - good to see and revise common steps
  - good to find steps to merge
  - less easy to comprehend (hard to imagine goal sequences)

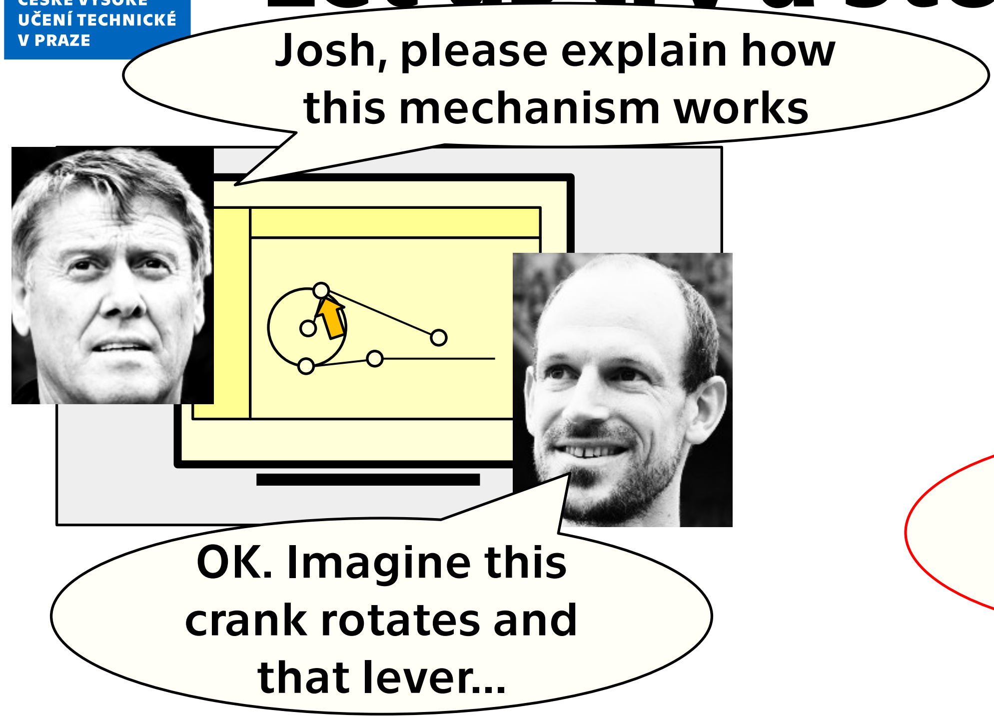
# Information architecture is stories

- We **do not have**
  - Any shape of the artifact
  - Consequently, anything **to draw**
- We **do have**
  - All output from formative phase (including Joe Lint's photo)
  - Information exchange sequences that satisfy all user goals
  - Possible actions on the intended platform
- **Our goal** is to make a successful artifact
  - So we draw **success stories** – stories of successful artifact use

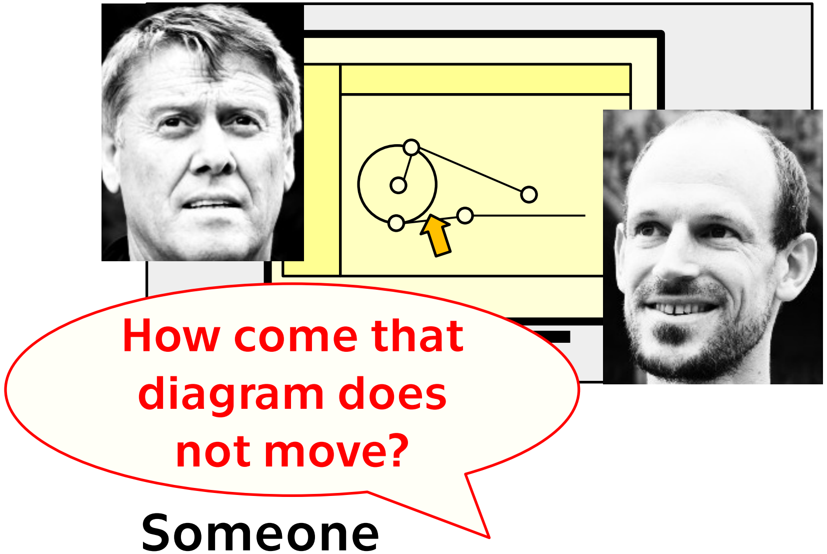
# Storyboarding

- Storyboarding (Walt Disney Studios cca 1933):
  - a story like comic stripe, individual sketches can be rearranged on a board („storyboard“) to for alternative sequences
- Based on **stories** from user research
- Telling **a message** – how to handle the interaction, where possible problems are
- Placed in **a situation**
- Finds key **moments/steps**
- Those are **drawn**
- And **arranged so that** the sequence(s) are clearly visible and easy to understand

# Let us try a story...

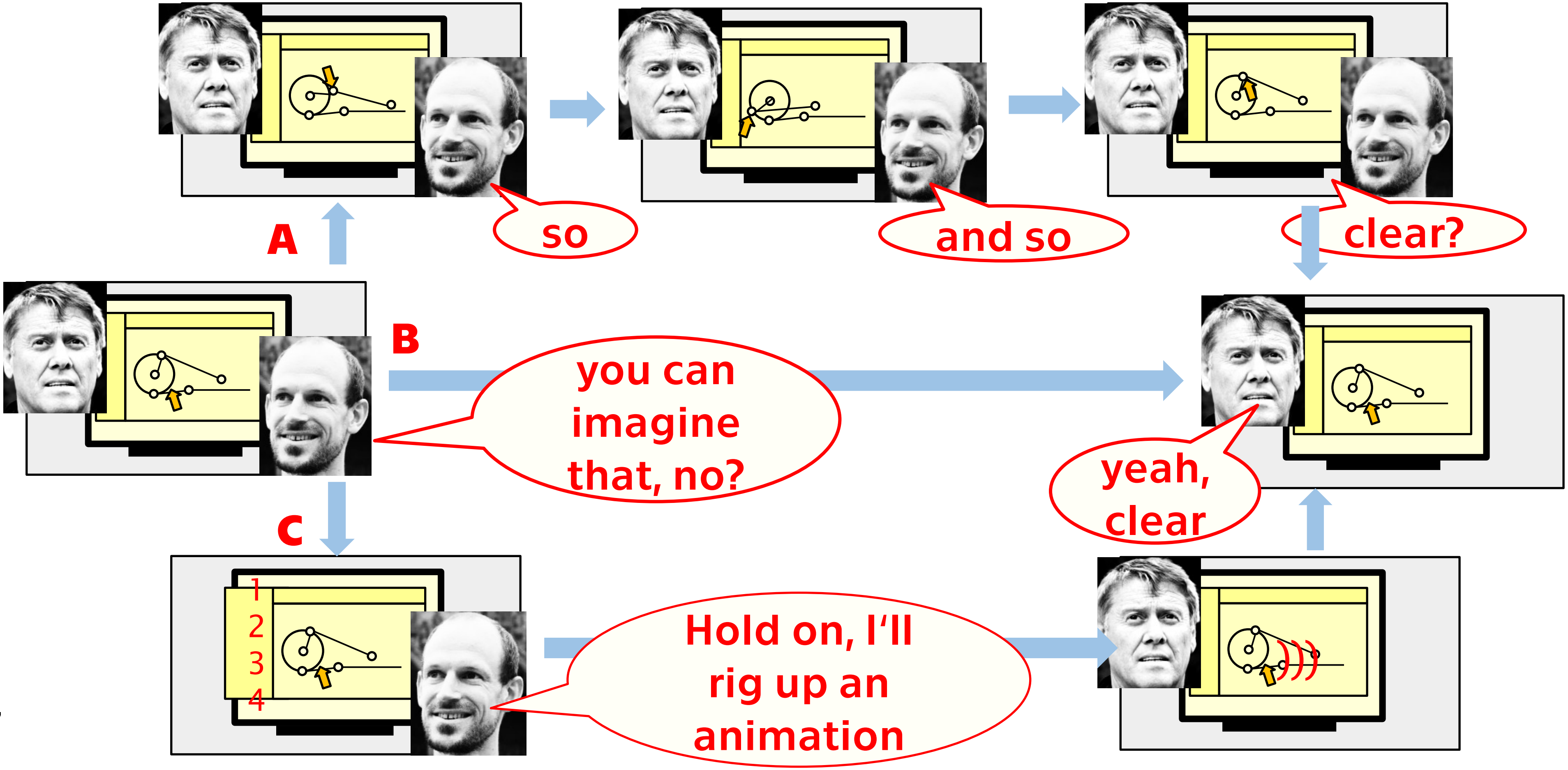



**situation...**
intended message:
**easy communication**




Someone
from the design team,
on behalf of Joe
**The story is not plausible**

# Let us sleep on it… (thrice)



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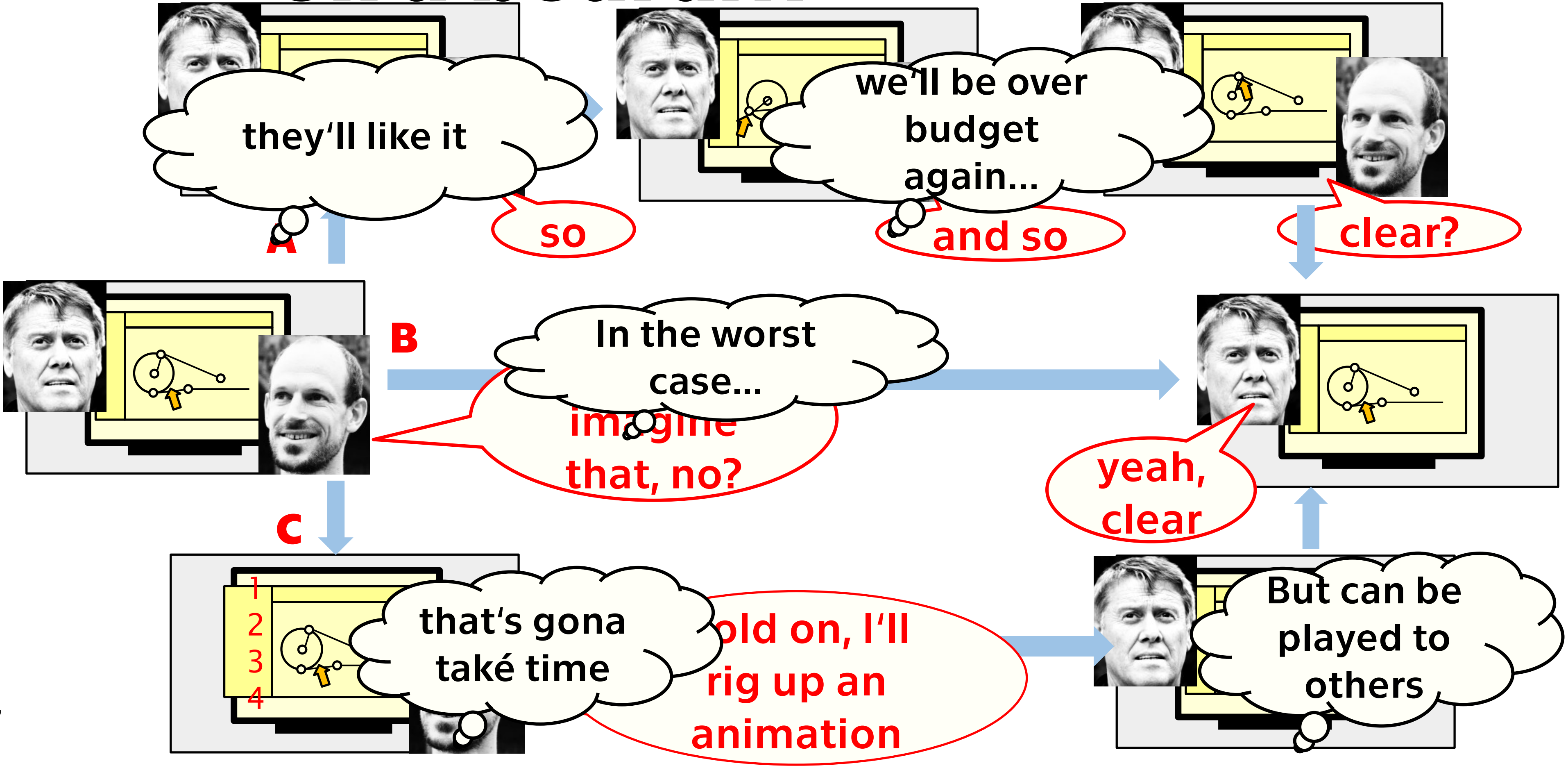
# Put the three designs on a board...



# So that…

- In a combined team, we will make the decision **with our users**
  - the users tell how important it is to have archivable animations
  - the developers tell how much effort would the implementation take
  - the UX teams tells how to do direct manipulation and/or animation scripting

# A summary

- Information architecture designs the way information is exchanged with the users
- Follows from user goals, depends on quantitative circumstances
- Includes styles of interaction, navigation, and presentation
- Interaction based on recall can be done in 1D, can use intension
- Interaction based on recognition needs 2D
- When an artifact reacts differently to the same input, the information needed to determine the reaction is state
- Information architectures are communicated by stories, commonly in storyboards

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# DESIGN AND PROTOTYPING


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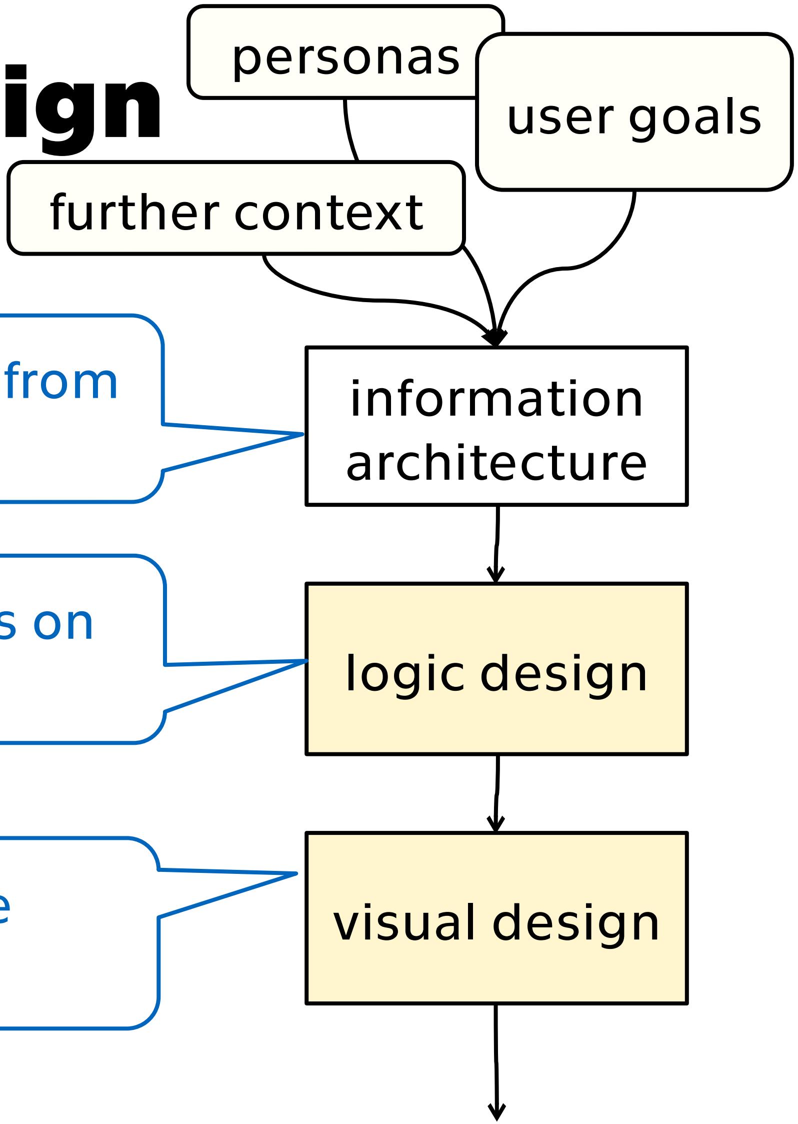
- Logic design
- Visual Design
- Mockups and prototypes
  - paper
  - electronic

# Interface design

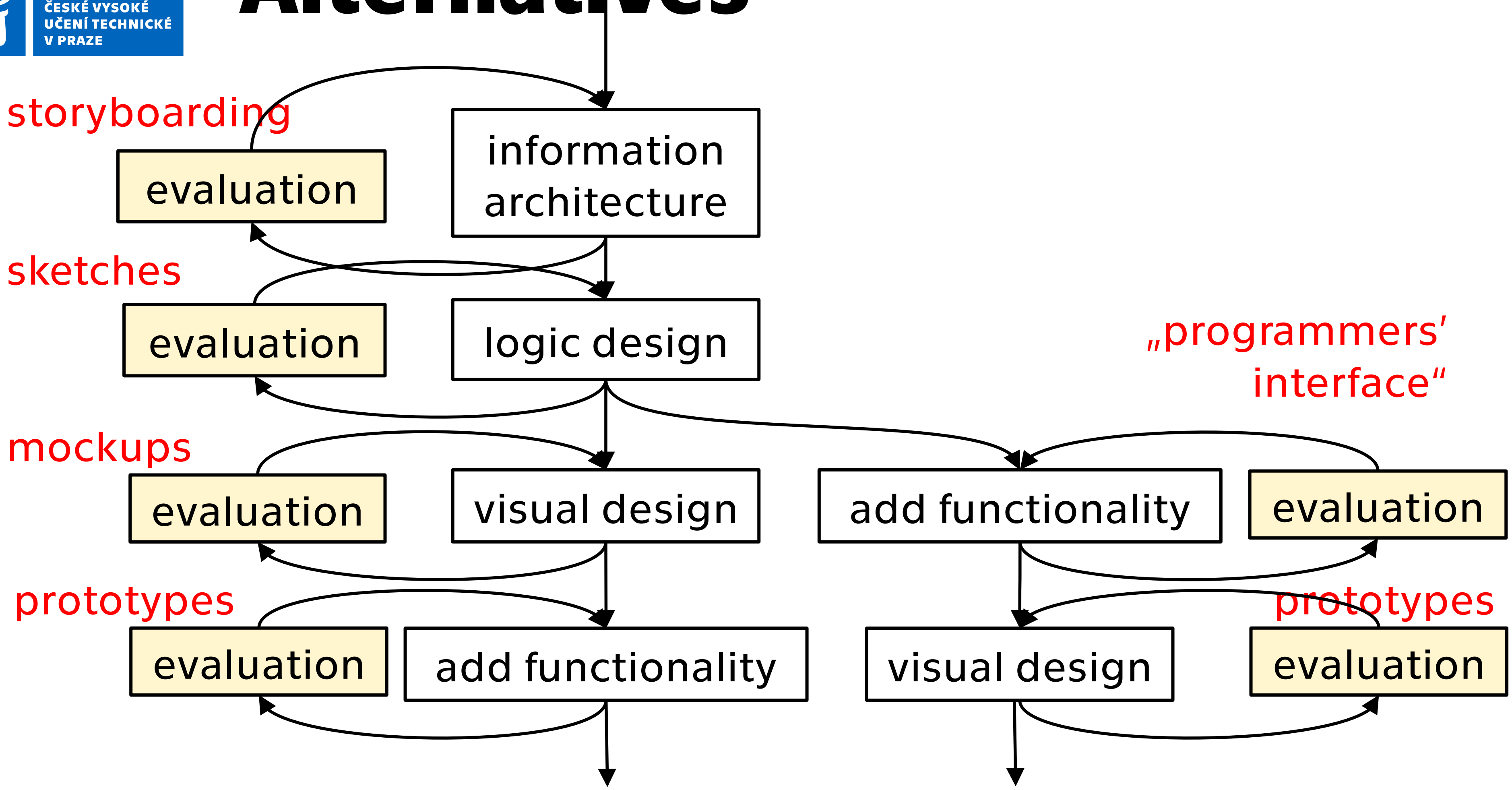
How to represent information – to and from the user

What information and control elements on a page – what is their hierarchy

Visual presentation of the logic and the hierarchy, visual focus guiding



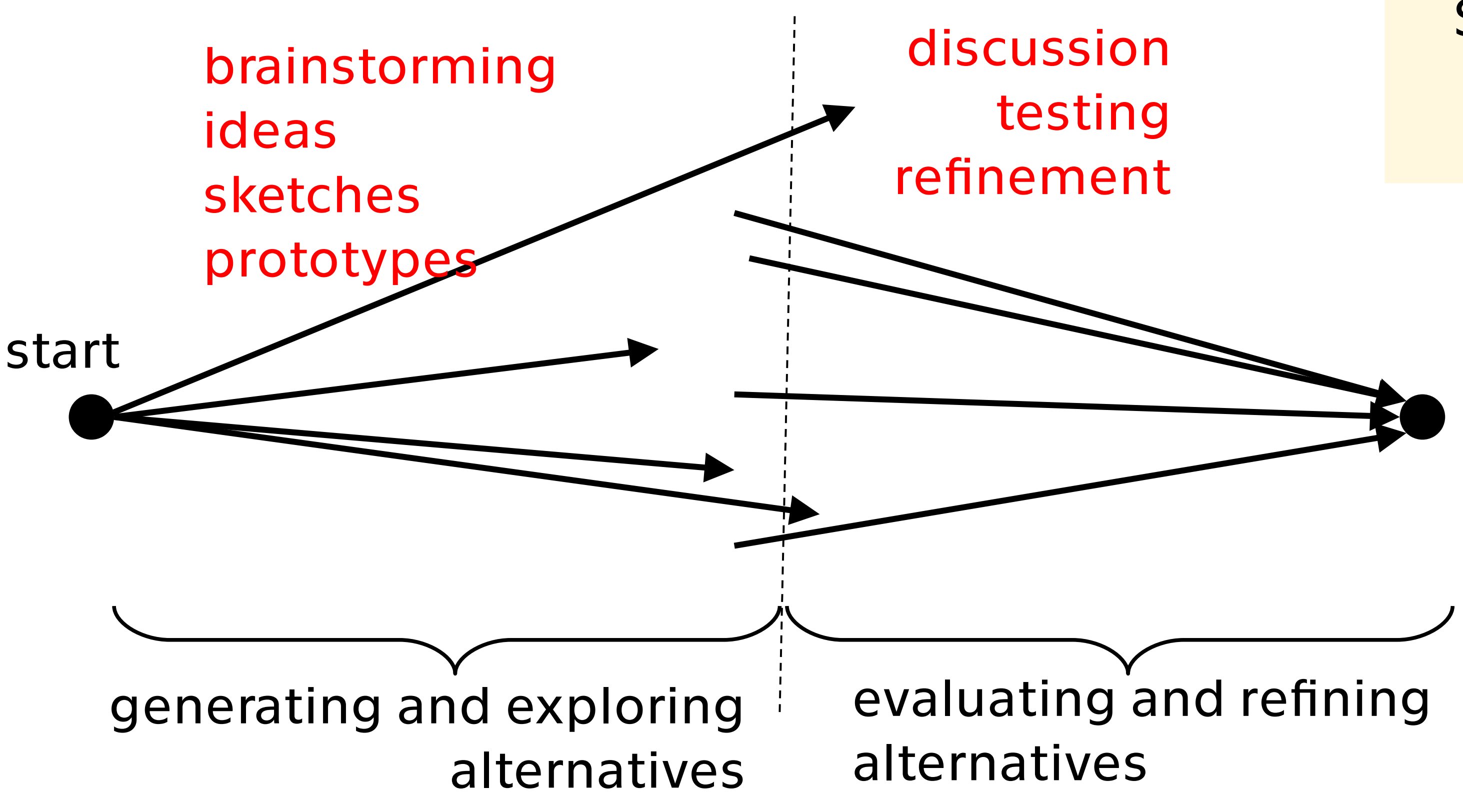
# Alternatives



- Information architecture finds ways of communication, determines how the artifact is composed of parts (pages, windows)
- Logical design determines how a page or window will fulfill its role in the artifact using information elements and actions
- Two possible workflows can follow.
  1) Visual design is done and tested on mockups; functionality is added afterwards and tested on prototypes.
  2) A visually simple but functionally complete interface is made based on logical design, so called “programmer's interface”; after testing, the final visual design is added and evaluated.

# Design process – any step

Sketching User Experiences, Bill Buxton



- Any design (and engineering, too) begins by generating ideas, different approaches, possibilities; creative group techniques can be used here.
- Then, those ideas are evaluated, compared, tested; again, group techniques can be useful.
- This is repeated for any stage of the design (information architecture, logic design, visual design)
- If necessary, multiple variants may be kept even across design phases, if the amount of work is feasible.

# LOGIC DESIGN

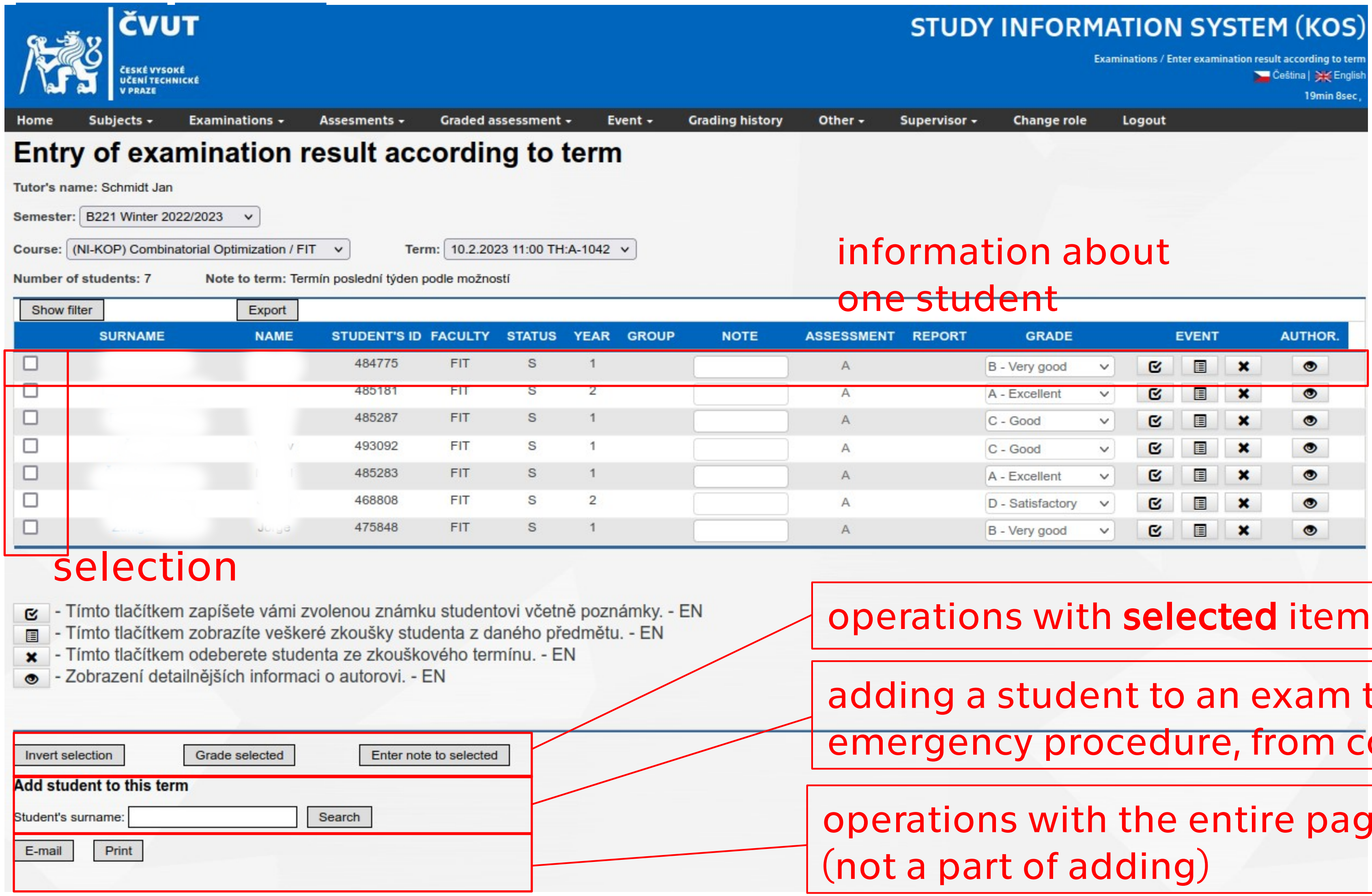
# Logic design of a window, page

**The starting point:** the role of the page in the architecture

- Actions:
  - What actions are needed for (partial) goals?
  - How the actions are commonly presented?
  - Which actions are similar, linked?
- Display:
  - What information is needed for actions, as a final product?
  - How the information is commonly presented?

What actions manipulate what information?

**The goal:** a hierarchy of page elements by their meaning




information about one student

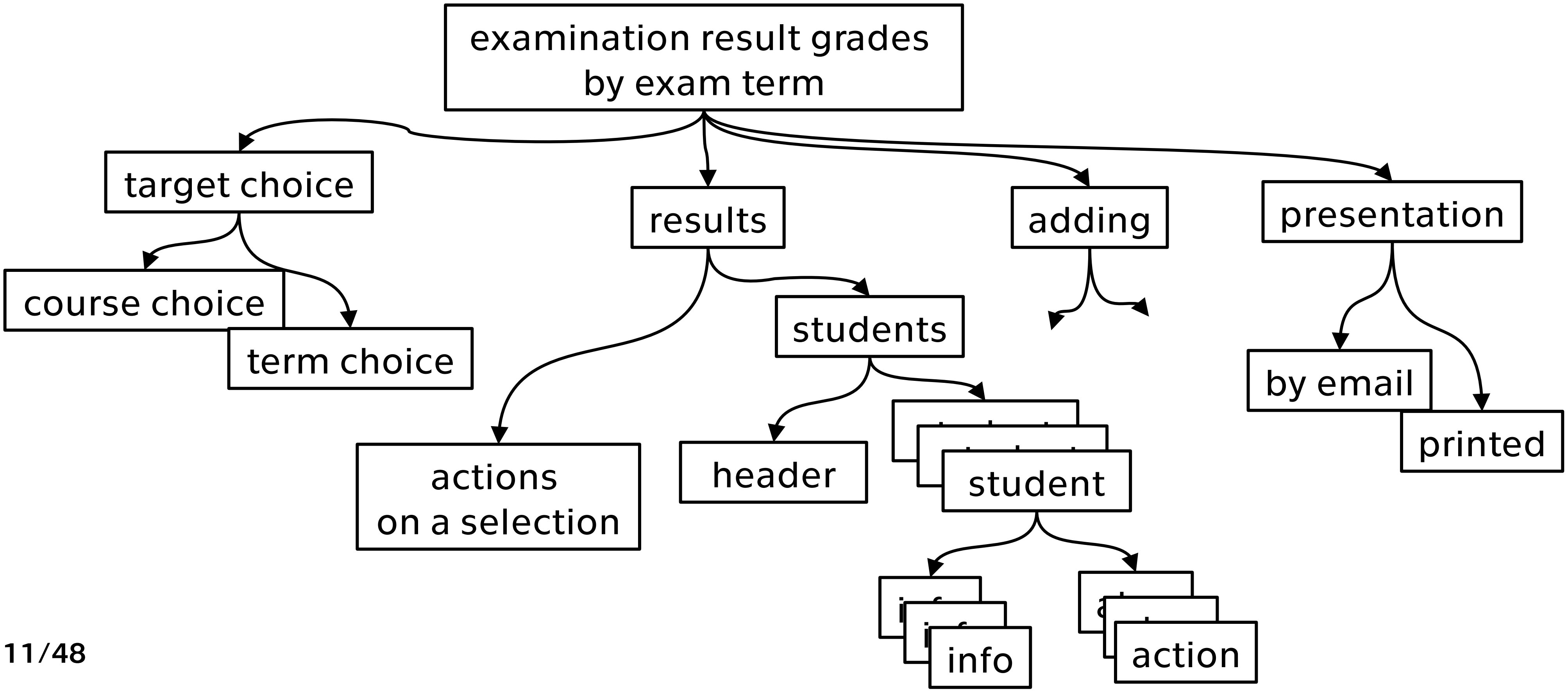
selection

operations with **selected** items

adding a student to an exam term: an emergency procedure, from context analysis

operations with the entire page (not a part of adding)

# Hierarchy within a page



# Interaction is a dialogue in a language

- The language has its lexical elements
  - commands and options etc. in a command language
  - manipulations (e.g., drag and drop) in direct manipulation
  - buttons, sliders, menus in indirect manipulation
  - gestures
- The language has its syntax
  - defined options sequence in a command line
  - defined action sequences: object-action, action-object
- We can speak our everyday boring language
- Or invent a beautiful language no one knows

# Reaction times in a dialogue

- Real communication environment: noticeable **latency**
- Reaction time is a **feedback**
  - „Normal" reaction time, learned
  - Shorter: command ignored, failed, …
  - Longer: no feedback, unknown system state (crash, cycling…)
- Lazy system ⇒ lazy user (measured!)
- The **granularity** of a dialogue
  - Less information in one „turnaround" of the loop: slow work
  - Much information in one „turnaround": faster, but feedback more scarce, possible information loss in case of error

# VISUAL DESIGN

# Visual design

- To visually represent the **logic design**
- To present the connotation of order
- To present further required connotations
- Graphical means: **contrast**
  - in position: proximity and distance
  - in brightness: emphasis
  - in shape: similarity
- Graphical means: **arrangement**
  - embedding (frames etc.)
  - alignment
- How do they work?

# Humans in an environment

- Understanding, mental modeling, manipulation
- Distinction and recognition by the contrast in
  - shape
  - structure
  - color
  - movement
  - uniqueness

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# Contrasts at work

# Contrasts at work: position

- These pictures illustrate a point in an old debate about analog and digital displays, their advantages, etc.
- There was an argument by an old pilot of the B-52 bomber (instrument panels in the picture): it was easy to detect which of the 8 engines is malfunctioning, because its indication was **different** from the other seven.
- In the lower photo, it seems that #4 is not OK...

# Using contrasts

The perception of contrast has some tolerance and adaptivity; small contrasts are filtered **out** or perceived as an error.

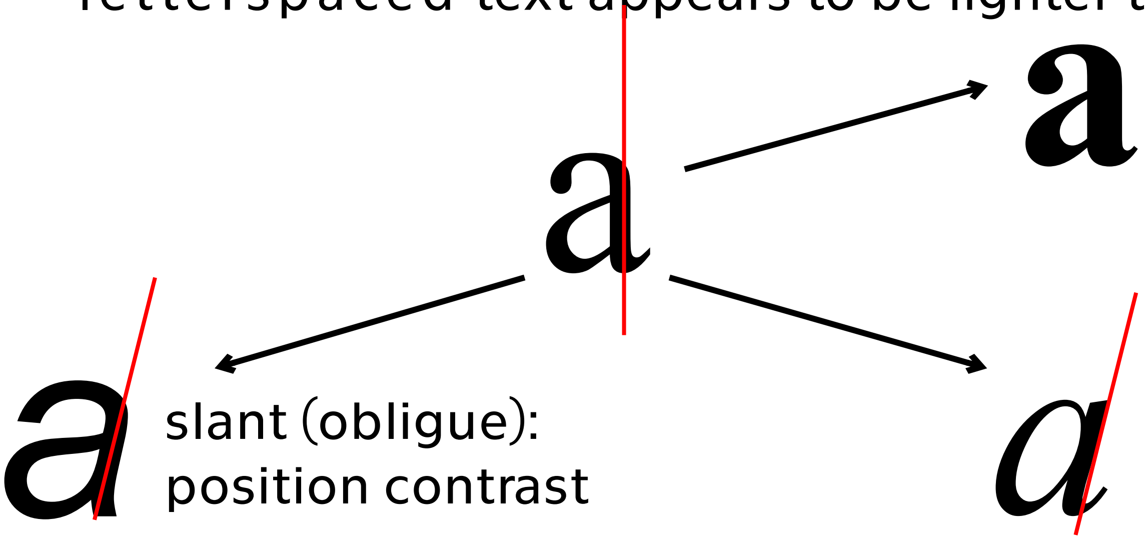
Low contrast is dull, static, inexpressive

**High contrast is dynamic, *agressive***

- Too low and too high a contrast causes perceptive fatigue.
- The „right“ amount of contrast in each aspect depends on the user and many other conditions

# Contrasts in typesetting

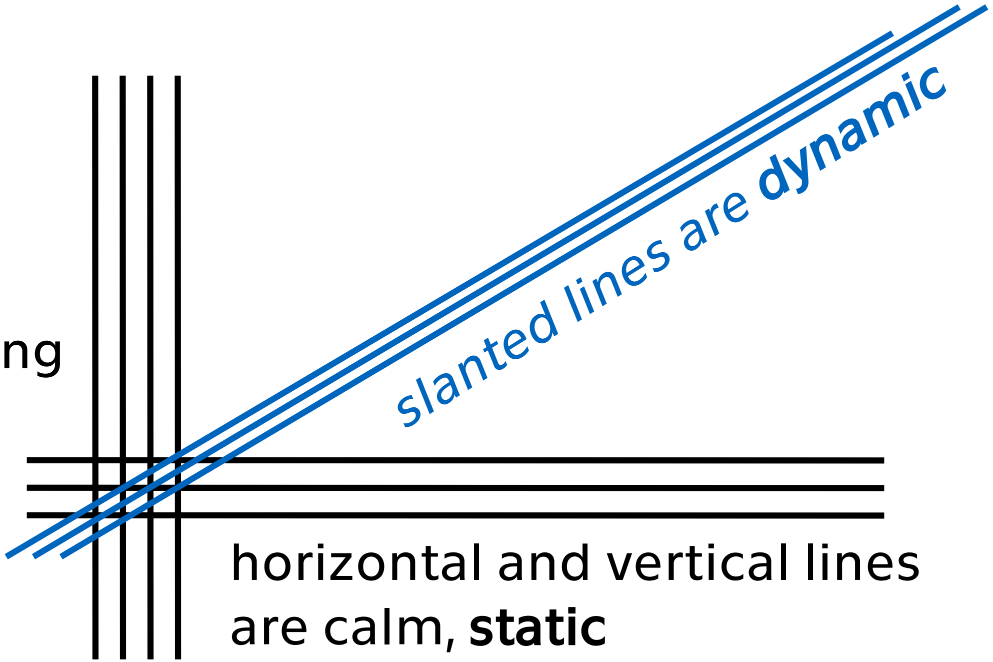
- Brightness contrasts
  - bold text appears darker („heavier“) than normal text
  - **bold text appears darker („heavier“) than normal text**
  - letterspaced text appears to be lighter than normal text
  - letterspaced text appears to be lighter than normal text




italics:
position and shape
contrast

# Static and dynamic scenes, visuals

- Understanding, mental modeling, manipulation
- Static configurations are safe
  - they do not fall or collapse
  - they are balanced
  - they are symmetric
- Static configurations can be boring



# Color

- Colors do not have “intrinsic” meanings
- Common meanings can follow from
  - common experience
  - common usage
- “Common” can mean a group or culture of any size
- The notion of warm and cold color: subjective to a degree
- White: in the East, the color of grief
- Black: in the West, the color of grief

# An example: red

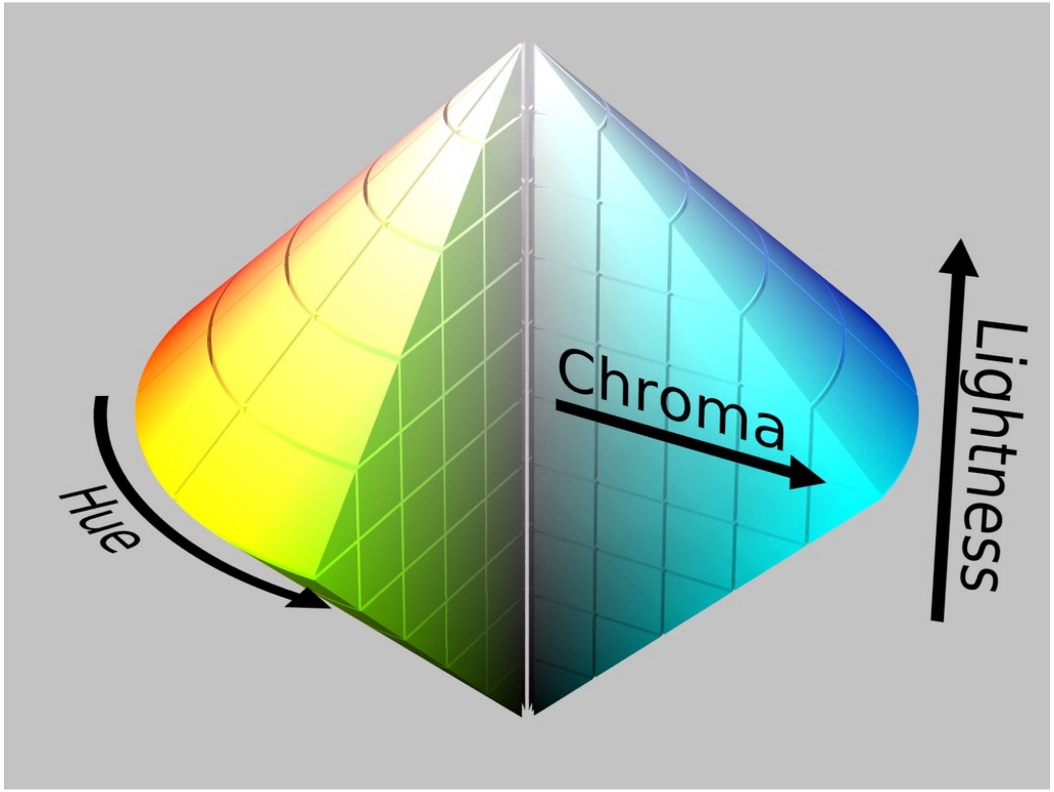
- Possible experience

- red
  - edible fruit
  - blood
    - prey
    - harm
  - fire
    - conflagration
    - warmth

- Which would apply to this operator's logo?
- In the East, red is the color of joy
  (e.g. a bride's clothing)
- Red light for the 'danger' aspect in railway signaling was introduced by the Railway Conference in Birmingham, 1841, as the best-visible non-white light, based on experiments by the Chappe brothers, 1763

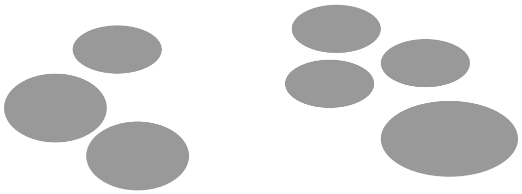
# The color model

- In aesthetics, art, HCI: most often the HLS model
  - Hue
  - Lightness
  - Saturation/Chroma
- **Contrasts**
  - in tone (maximum: complementary colors)
  - in lightness
  - in saturation

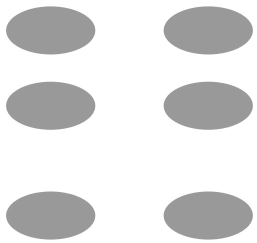


# Grouping, organization

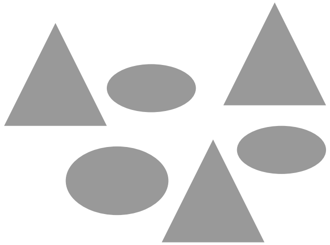
- Grouping, organizing, by:



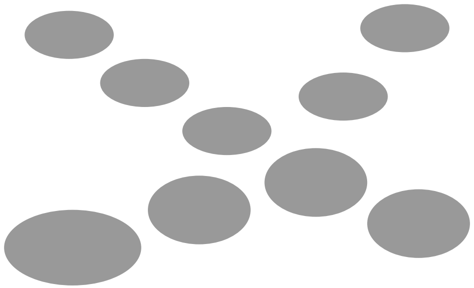
proximity



closure



shape contrast



continuity

color/brightness contrast

# One or two groups?

**Choose a language**

- ◉ Czech
- ○ English
- ○ German
- ○ Italian
- ○ Serbian
- ○ Croatian
- ○ Albanian

# Initial point of attention

The first point in a scene which gets attention is an object which differs. The difference lies in contrast; the contrast might be in color - a colored element in a black and white page;
in structure - graphics in text; both principles work when marking a part of the text e.g. by **bold typeface...**

by its isolated position

X **FATAL FAILURE**

# Guiding attention

The direction of attention movement is culturally dependent

Along some virtual line

From one cluster to another cluster

The tendency to move along a line

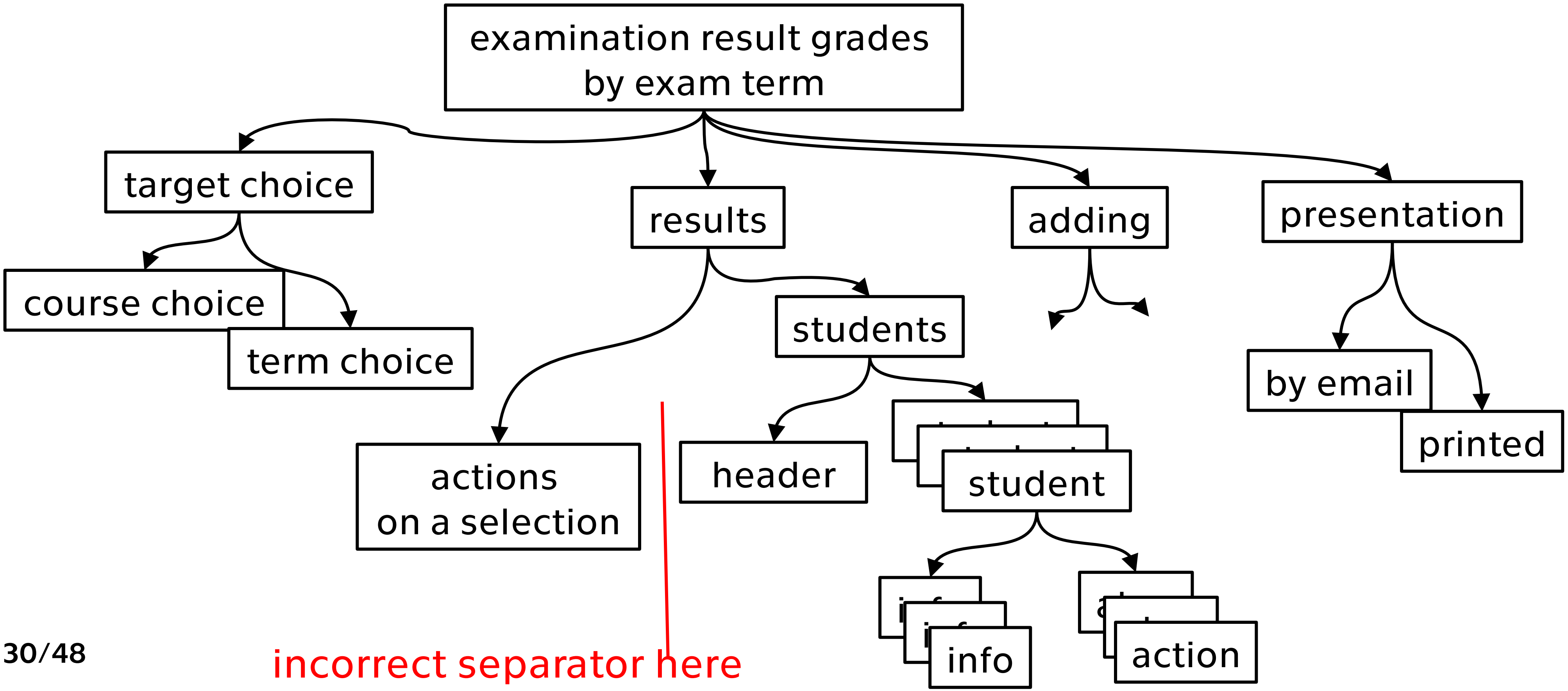
can be made stronger

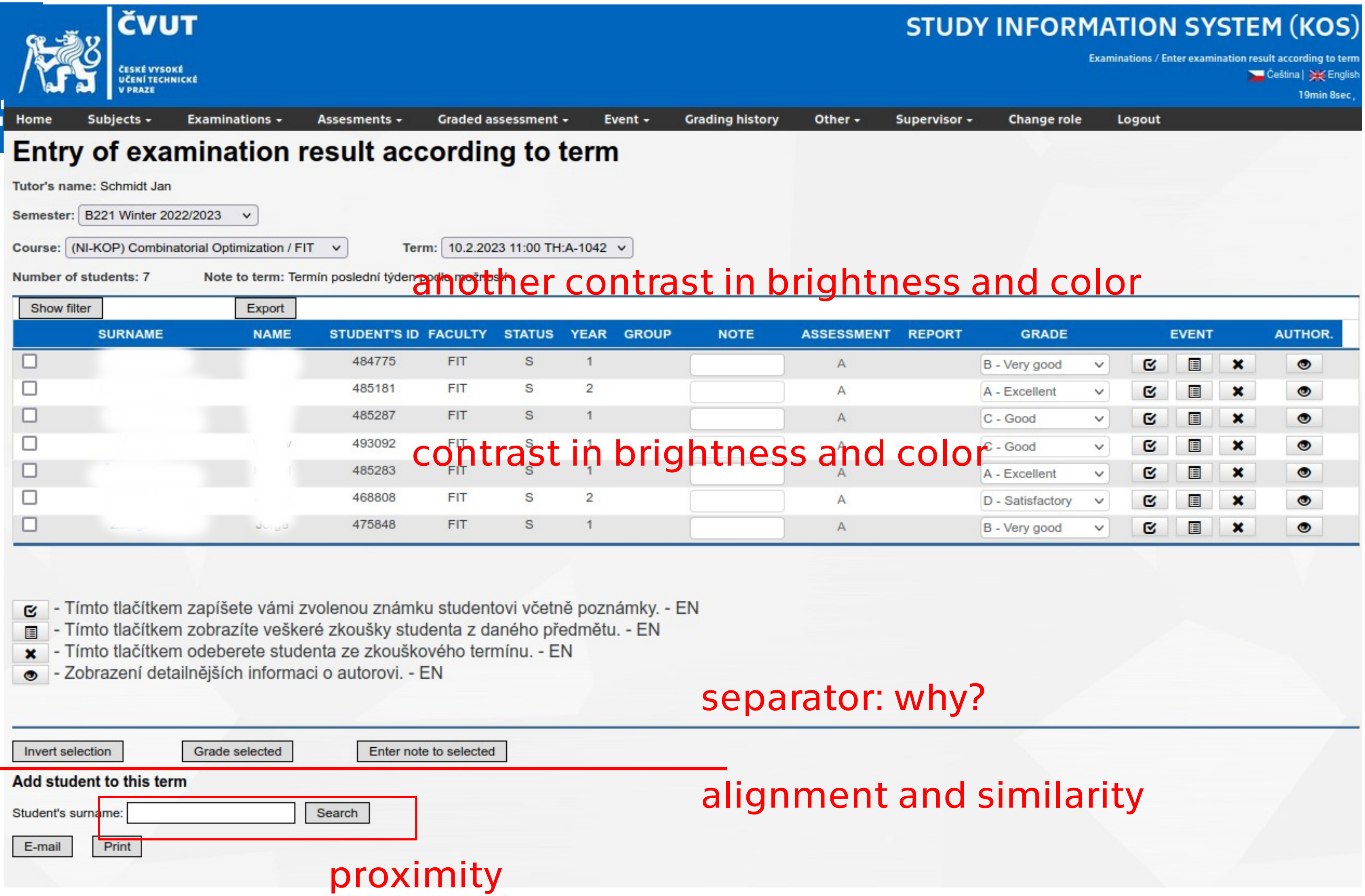
by drawing a real line

★ ★

Between striking elements

# Hierarchy within a page






another contrast in brightness and color

contrast in brightness and color

separator: why?

alignment and similarity

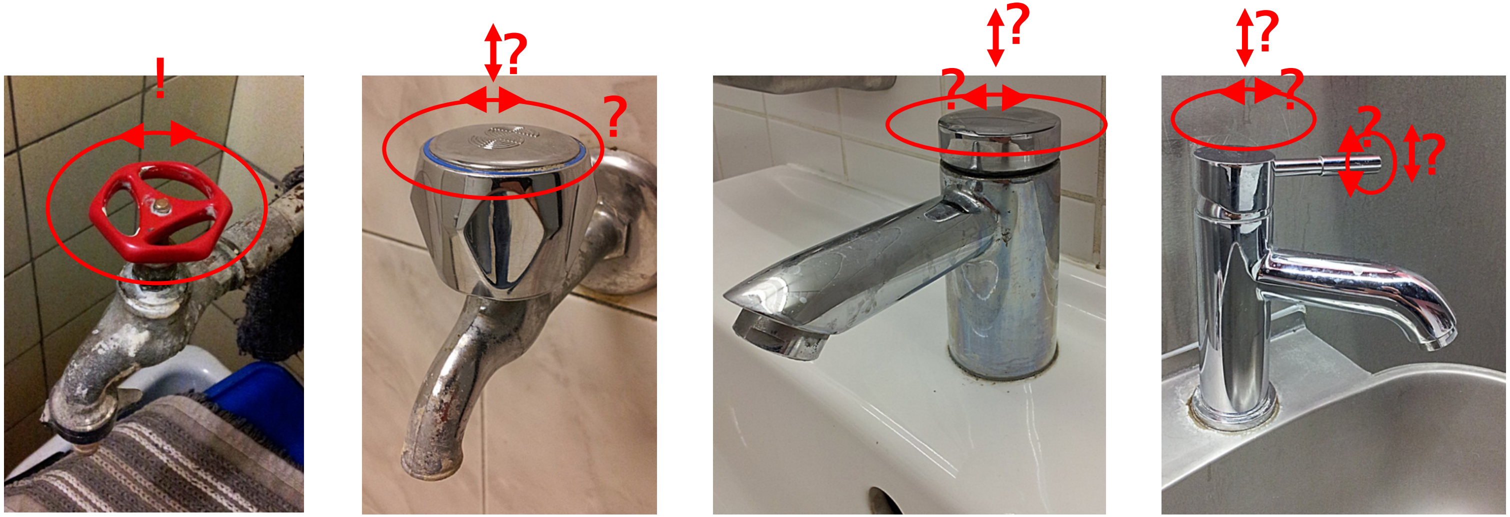
proximity

# Grid

- A system of imaged lines
- Often unified for the entire artifact
- Representing logic
- Presenting connotations:
  - our thoughts are well-ordered
  - we took care about the design so that the user can receive the content easily

# Affordances

- How an object offers ways to be manipulated
- Based on previous experience



- A tap should look as a tap
- A button, a link should look like one

# Affordances

- **Explicit**
  - Physical – a raised button
  - Using language – „Click to…"
- **Patterns and conventions:** the hamburger button
- **Hidden:** appear in a situation only – mouse over
- **False:** red for "OK"
- **Metaphoric:** an analogy with another control or with reality – sliders
- **Negative:** „this is fixed"

# MOCKUPS AND PROTOTYPES

# Prototyping is communication

a reminder

- Communicate the current state of the design
  - To make opinions
  - To evaluate
  - To improve
  - Finally, to discard (**working material only**)
- **Communicate to**
  - UX team members (knowing UX jargon, diagrams…)
  - Our collaborating users (knowing little about UX, a lot about their work)
  - Our customers
  - **… as all those must understand it**

# Mockups and prototypes by purpose

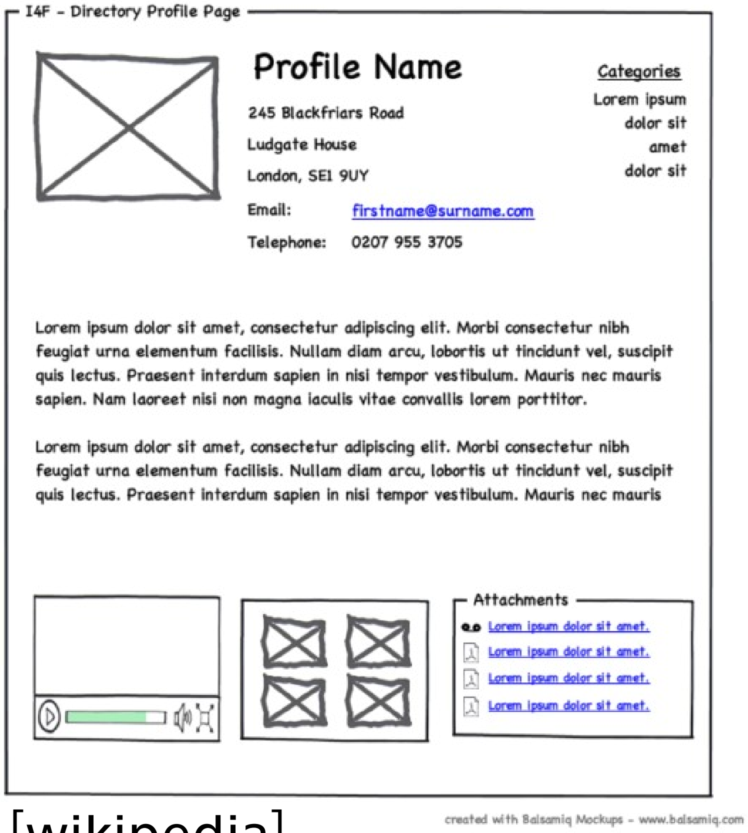
- For **logic design**
  - Only element hierarchy and attention sequence matter
  - Proximity, arrangement important
  - Low-fidelity mockups and prototypes
  - Paper or electronic
- For **visual design**
  - Aesthetics, connotations, satisfaction, balance matter
  - Platform-defined widgets important
  - High-fidelity prototypes
  - Mostly electronic

# Mockups or prototypes?

- If it is interactive, it is a **prototype**
  - simulates interaction by any means
  - can communicate and test transitions (clicks etc.)
- If it is static, it is a **mockup**
  - still can represent element hierarchy, visual balance
- There is no clean border
  - a mockup can be made interactive using very simple methods
  - a prototype can be evaluated for static properties

# Wireframes

- The arrangement **has to reflect** the hierarchy – somehow
- The arrangement could reflect focus sequences
- Don't let designers waste their time on elaborate wireframes – **the idea is all**
- Don't let the users to see it too valuable – they would not criticize

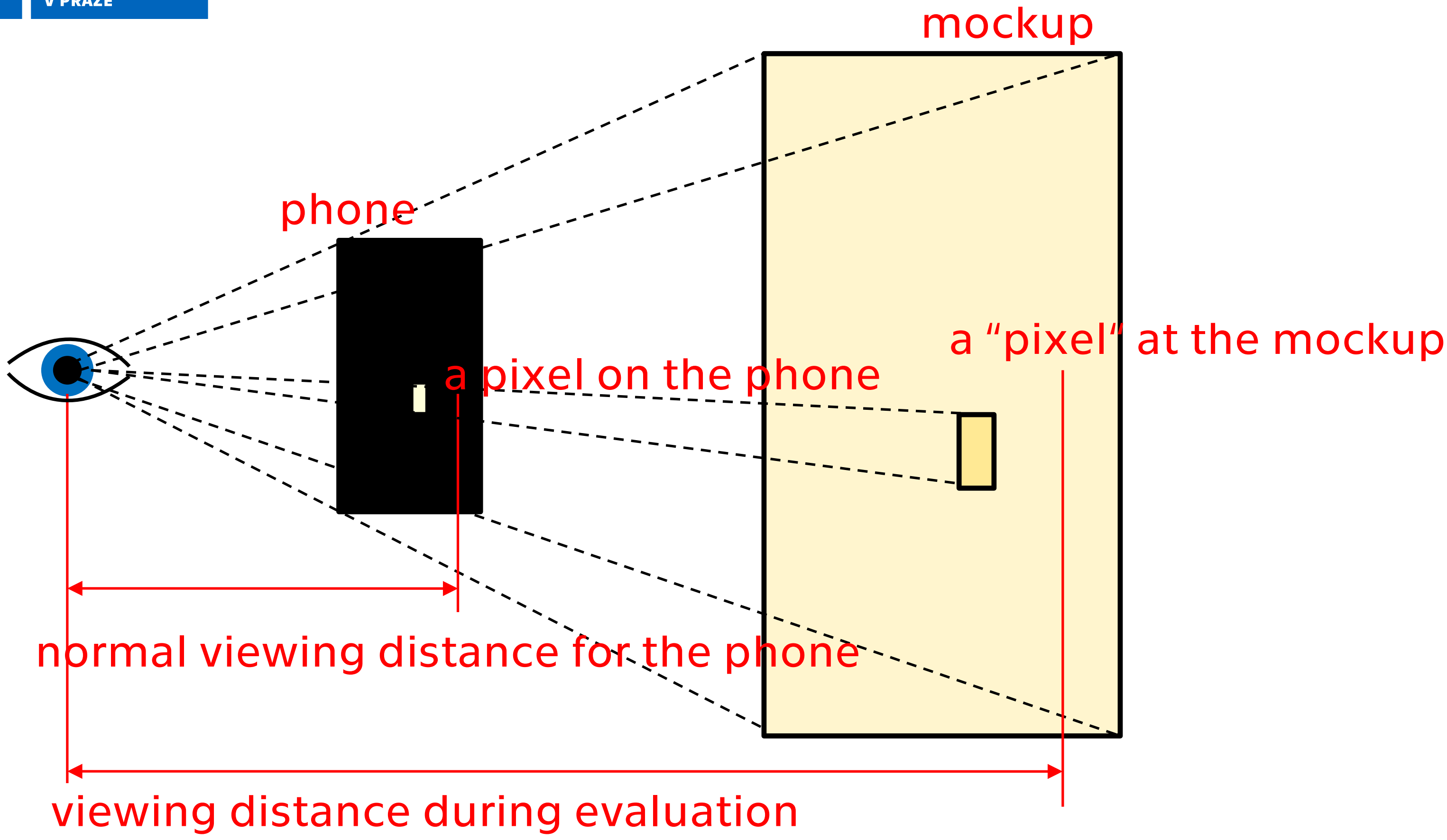



[wikipedia]

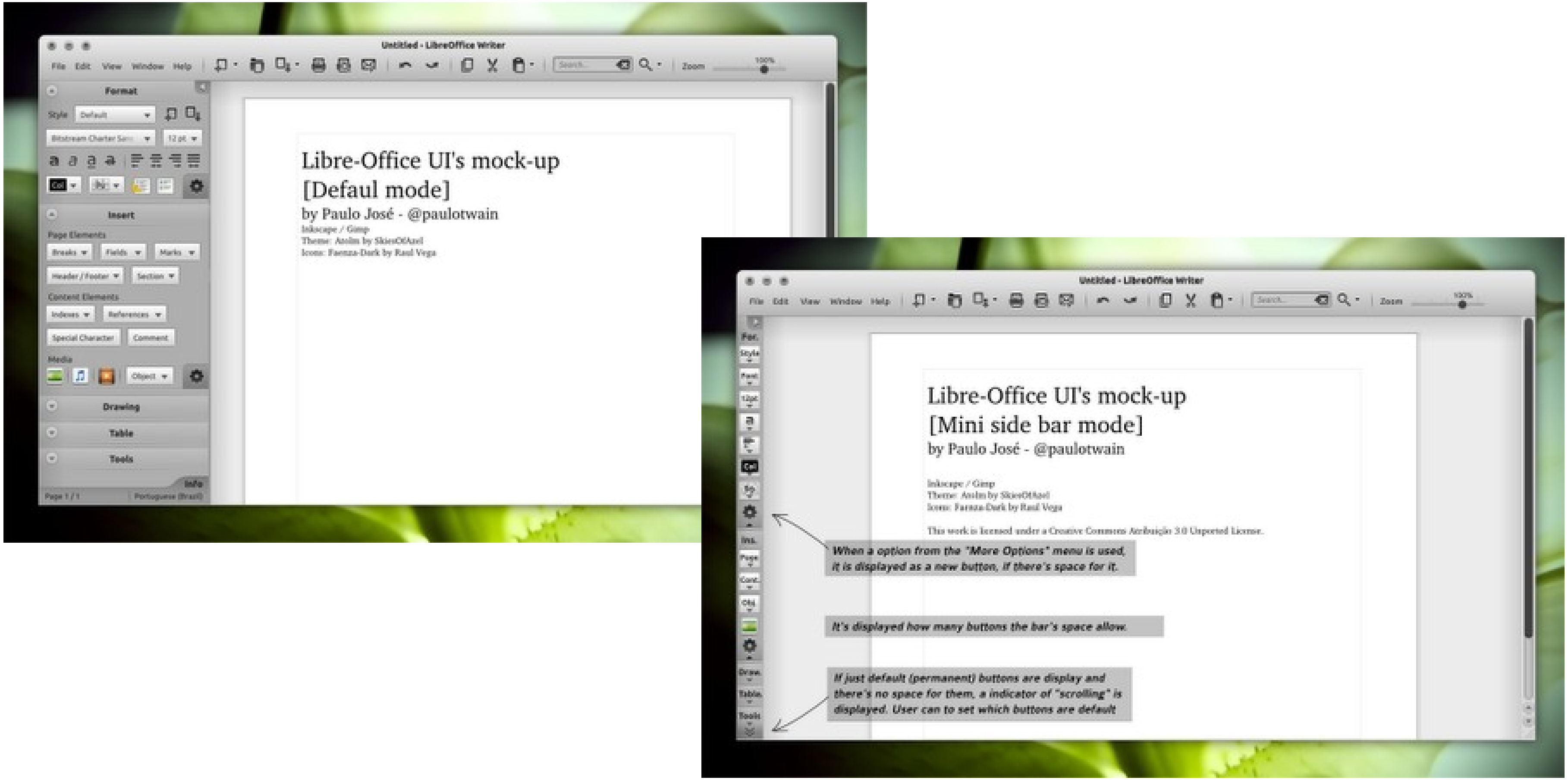
# From mockups to prototypes

- Chauffeured mockup
  - Components drawn on pieces of paper and cut (beware of scale – how large is a pixel?)
  - Testing a sequence of actions (a method)
  - The user controls the interface by pointing, saying
  - The “chauffeur” moves and exchanges the elements
- Wizard of Oz
  - Similarly, but by programmatic means and remotely

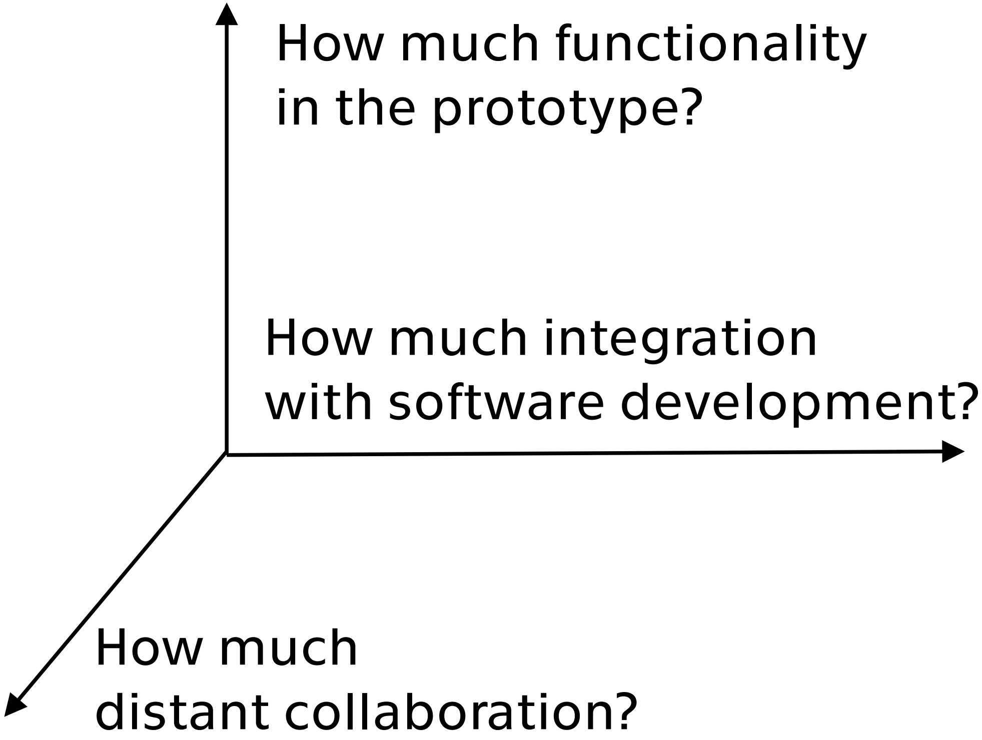
# Mockup scale



# Prototypes


Untitled - LibreOffice Writer
Format
Insert
Drawing
Table
Tools
Libre-Office UI's mock-up
[Defaul mode]
by Paulo José - @paulotwain
Libre-Office UI's mock-up
[Mini side bar mode]
by Paulo José - @paulotwain
When a option from the "More Options" menu is used, it is displayed as a new button, if there's space for it.
It's displayed how many buttons the bar's space allow.
If just default (permanent) buttons are display and there's no space for them, a indicator of "scrolling" is displayed. User can to set which buttons are default

# Electronic mockups and prototypes



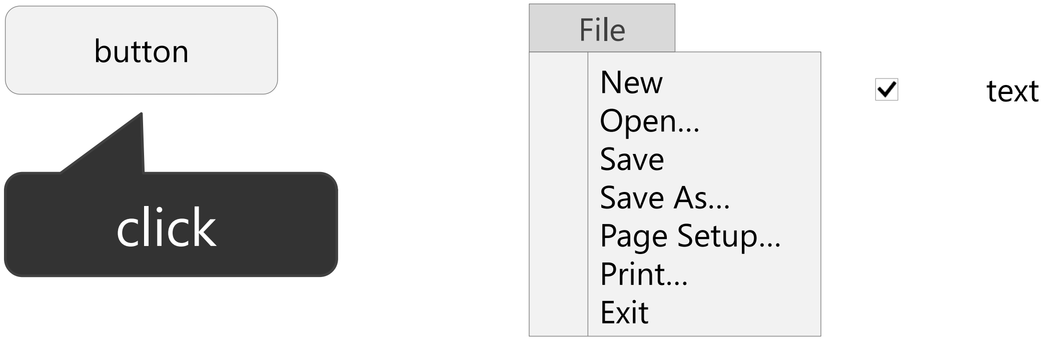

- In other words, what cannot serve as a prototype?
- In which situation?
  - small team, low-tech
  - professional work, emphasis on speed

# Drawing tools

- Static figures only - but chauffeured mockups possible
- Repeating parts easy to copy
- Elements libraries can be used
- Example
  - inkscape

# Diagrammatic tools

- Similar drawing abilities, similar library support
- Support for (simple) scripting ⇒ **dynamic prototypes**
- Example:
  - Visio: Visual Basic; element library for Microsoft Windows, templates and controls for web and mobile apps
  - Visual Studio + PowerPoint: shape libraries for import, actions, annotations, teamwork



# Hypertext tools

- In each textbook : Apple HyperCard (but in no computer)
- Both local and web-based tools (HTML, CSS, JavaScript…)
- Some interaction styles not supported well or natively (drag and drop, gestures) … ?
- Example: JustProto (http://www.uxpin.com/)
  - Element library, elements instantiated by drag and drop
  - Basic action, bound to elements
  - Collaborative: concurrent editing, communication

# Visual programming

- Nearest to real software
- Identical element library
- Easy to achieve accurate look
- Functionality programmed in target language
- The result is painful to discard

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# Work fast

- **Initial phase:** paper mockups and prototype are the fastest, esp. with some experience
- How to choose prototyping tools?
  - one for all phases (less learning)
  - one for all team members (sharing)
  - one for all target platforms (consistency, experience)
  - a tool designed for prototyping from the start
- Collaborative tools where **necessary**
- Infrastructure for prototype distribution and feedback gathering
  - user annotations?

# USER INTERFACE EVALUATION

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# WHY AND WHEN

# Evaluation and design

- HCI evaluation is always with respect **to the users**
- Evaluation is **analysis**
  - We have something (an artifact, a prototype)
  - We want **to check** its properties
- Evaluation is **asking questions**
  - Does it cause any problems? (new artifact)
  - What causes known problems? (previous version)
  - Do the users interact with it as we suppose?
- Correct implementation assumed

# Questions

- **Formative phase** (context and domain analysis) - next lecture
  - What is the supported actitvity?
  - Who the users are, what are their abilities, …
- **Design phase**
  - Do we understand that situation? (in artifact usage)
  - Is this idea any good? (comparing variants)
  - Will the usability be OK? (of this prototype)
  - Where the trouble originates and where to focus? (if anything not OK)

# Questions

- **Summative phase**
  - Is the usability really OK?
  - Were our **assumptions** correct?
  - How is the **social acceptance**? (community, work teams, offices…)
  - What have we **learned** from the process?

# HOW?
# AN OVERVIEW OF THE METHODS

# Evaluation methods

- How the **user** is represented?
  - Real people
  - Hired people
  - Acting HCI experts
- What is the situation
  - Real (in the field)
  - Simulated (in a lab)
  - Analyzed and understood (by experts)
- How is the artifact represented (real, prototype, sketches)
- What kind of questions is to be answered? (qualitative...)

# Methods

- real users
- real tasks
- real artifact
- real environment
- real motivations

the goal: understanding

**interpretive methods**

- hired users
- controlled tasks
- real artifact
- controlled environment

the goals: checking, understanding

**usability testing**

the goal: measurement

**quantitative lab methods**

- users represented or simulated by experts
- controlled tasks
- a prototype

the goal: checking, prediction

**expert evaluation predictive methods**

# METHODS: PREDICTIVE

# Predictive methods

- real users
- real tasks
- real artifact
- real environment
- real motivations

the goal:
understanding

**interpretive methods**

- hired users
- controlled tasks
- real artifact
- controlled environment

the goals:
checking,
understanding

**usability testing**

the goal:
measurement

**quantitative lab methods**

- users represented or simulated by experts
- controlled tasks
- a prototype

the goal:
checking, prediction

**expert evaluation predictive methods**

# Predictive methods

- In situations, where
  - an early check on usability or early analysis is required
  - our artifact is still a prototype (most often)
  - our users are not available (can happen)
- Produce a list of (potential) **usability problems**
- The common principle: HCI experts **act as users**
  - based on their knowledge of HCI
  - based on given user characteristics (most often, **personas**)
  - pretending that the prototype is the real artifact
- Making the process more **structured** and reliable:
  - prepare questions that the experts answer

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# Imagining the users

- From the formative phase, we've got (supposedly) a plenty of quantitative and qualitative data on users
- **Hard to communicate** – how do we share our experience?
- We need to use the information to:
  - influence the artifact design
  - communicate the ideas to developers, customers, users
  - build consensus and commitment
  - evaluate the design (choosing hired users, telling the experts)
  - help promote the artifact (marketing)

# Imagining the users: personas

- A solution: an archetype of the user
  - we project all the information into a fictitious person
  - we give it a name
  - we give it a (suitable) face
  - we give it a (suitable) history
  - and we complete it to create consistent character
- Examples: see the “Project tour”
- More details later

# Expert, experts…

- **Requirements:**
  - The knowledge of application domain **and HCI**
  - The ability to „play“ users (even children?)
  - No bias: no relations to previous versions, no pet theories
- **Number**
  - Their usefulness (the percentage of detected faults) grows with the number of experts
  - Having many experts takes more time and costs than hiring users
  - 3 experts are a common compromise

# Two classes

**predictive evaluation**

Page by page,
window by window,
dialog by dialog …

By sequences of actions
necessary to achieve
**user goals**

**inspections**

**walkthroughs**

heuristic eval
for standards
for consistency

**hybrid methods**

heuristic walkthrough

cognitive
pluralistic

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# PREDICTIVE METHODS: INSPECTIONS

# Heuristic evaluation

- Evaluating all parts of the artifact: an inspection technique
- Checking for a given set of heuristic rules, e.g.
  - does the system permit a recovery from any error?
  - does it speak with the users' language? (cf. "crossheads")
- Rules sets:
  - often Nielsen & Molich - see Nielsen heuristics
  - problem- or domain-oriented sets

# Further inspections

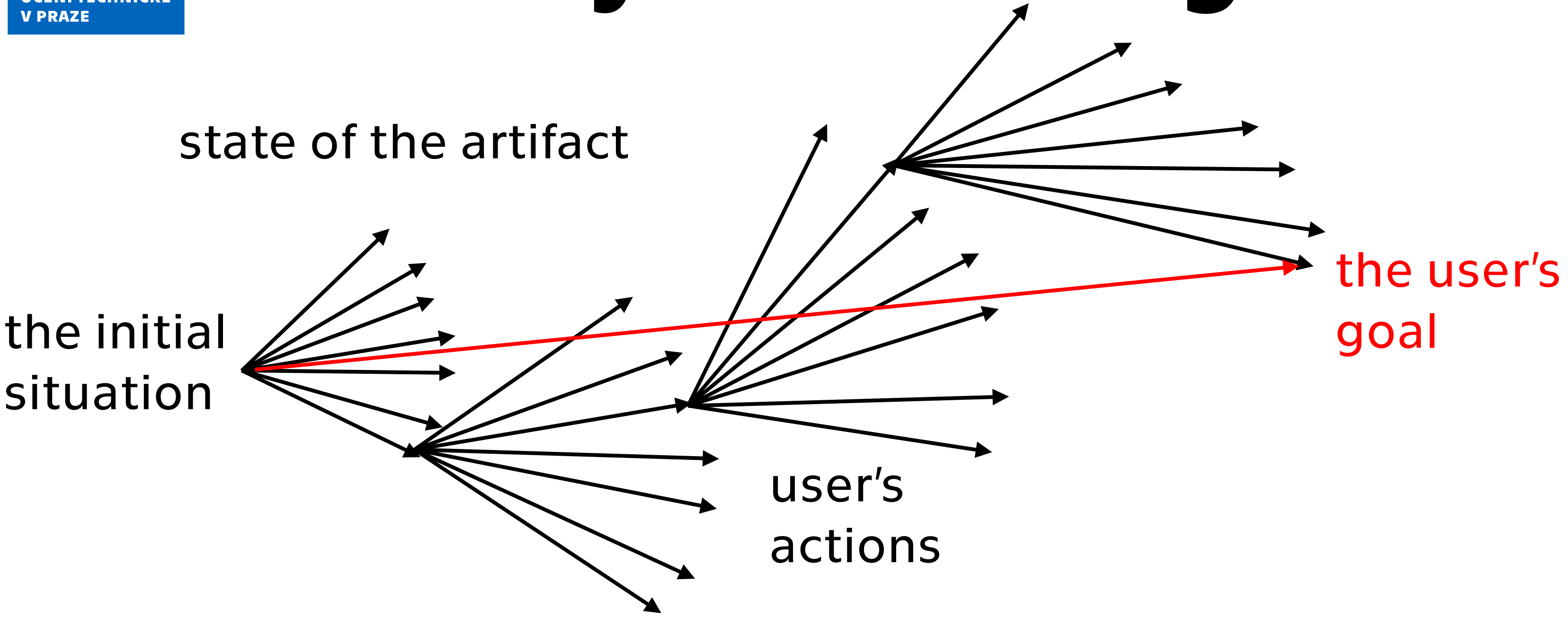
- For **standards**
  - enterprise standards
  - state standards, laws
  - platform standards: Human Interface Guidelines (HIGs), cf. [tests in Android HIG App quality guidelines]
- For **consistency**
  - internal,
  - external – defined by documents, rules
- For **features:** task by task, so not strictly an inspection
  - missing features
  - candidates to "creeping featurism"

# PREDICTIVE METHODS: WALKTHROUGHS

# Walkthroughs

- Answer question regarding **user goals**
- Walk through a sequence of actions that achieve such a goal
- Similar to manual simulations – walkthroughs of code

# The way to a user's goal




- Assuming: the user decides what to do next in each step, by the information acquired (as opposed to blindly repeating a learned sequence)

# An abstract model: GOMS

- **Goals:**
  - what the user wants to achieve
- **Operators:**
  - artifact manipulations (e.g. UI actions in an application)
- **Methods:**
  - operator sequences leading to a goal
- **Selection Rules:**
  - which operators preferred (apparently safe actions, keyboard shortcuts)

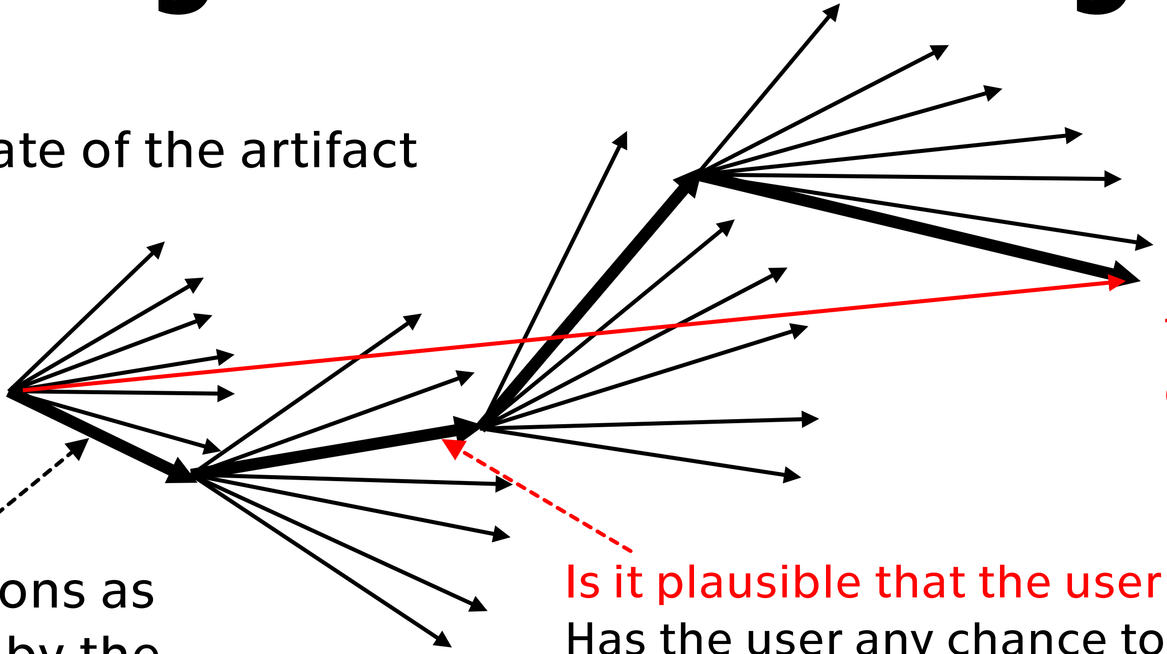
# Cognitive walkthrough

- A task-based technique
- Checking the **plausibility** of the expected sequence of actions
  - Checking the **possibility** of a correct operator and method choice
  - Checking the **plausibility** of a correct choice based on knowing the user
  - Checking the **response**
- Checking for **multiple error causes**
- Based on the GOMS theory, but not requiring deep knowledge

# Cognitive walkthrough

state of the artifact

the initial situation



the user's goal

user's actions as projected by the designers

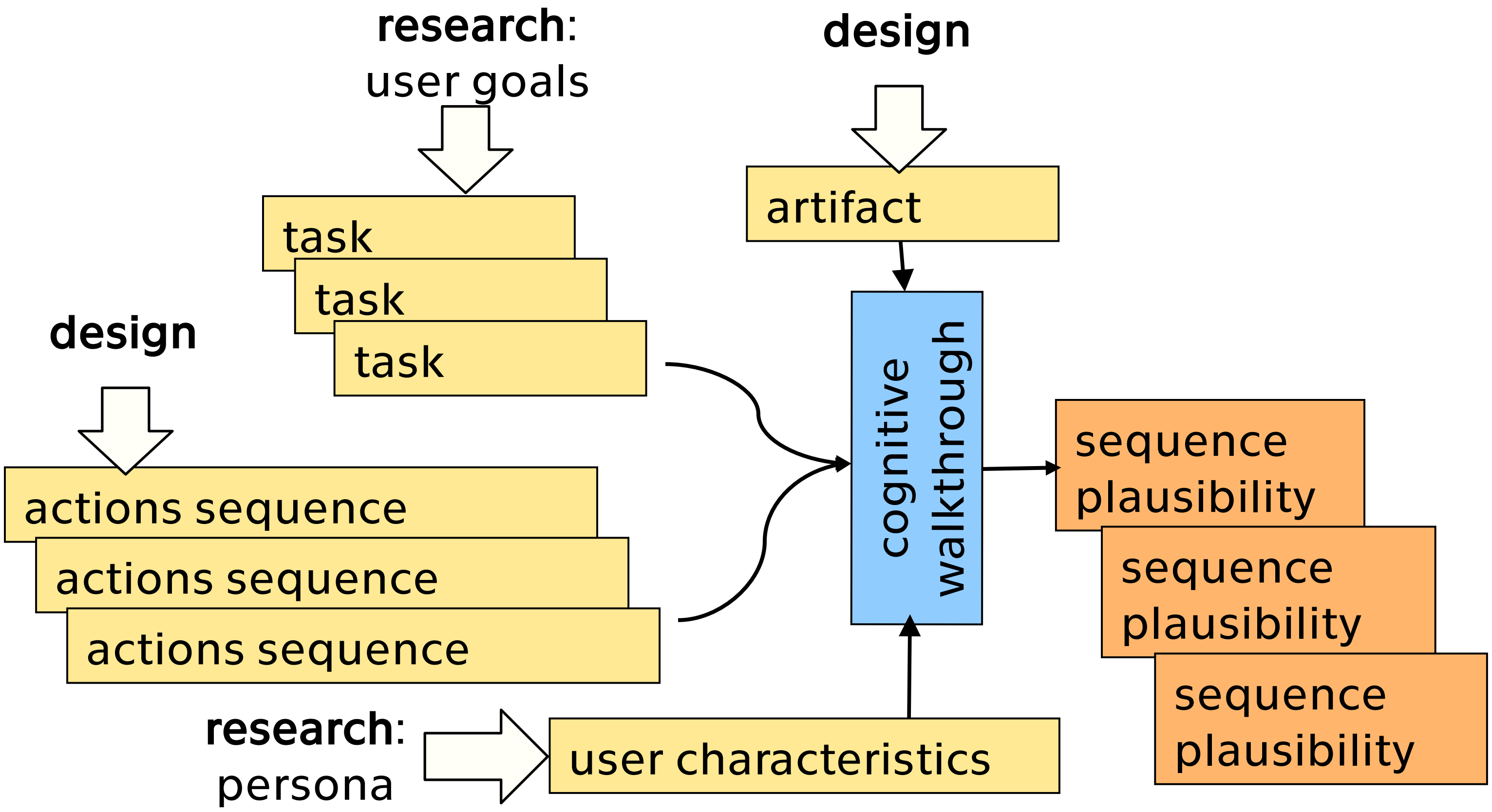
Is it plausible that the user will go this way?

Has the user any chance to notice this path?

Will the user really choose this path?

Will the user understand the response?

# Inputs, outputs



# We need

- **The artifact** – a prototype, a mockup, …
- User goals – from user research, context analysis
  - = something that makes sense even without the artifact
  - = something that needs a sequence of actions with the artifact
  - = something **entirely concrete** (with data, names,…) - or the results will differ and will become unreliable
- A **sequence of actions** leading to each goal, as projected by the designers
- The **user persona(-e)** – from user research, or at least another user's description method

# We perform

- For each task:
  - **take** the given sequence
  - (**do not discover it** - a frequent mistake)
  - for each action in the sequence
    - check, whther it is plausible, that the user performs it that way
    - if not, record why and continue (as if the user got the right idea)
- The result: a list of problematic situations, with reasons, to be handed to the designers
- How to check plausibility?

# Plausibility-checking

## a simple version

- Will the user want to perform such an operation?
- Is the correct action **visible** – that is,
  - really visible e.g. on the screen
  - otherwise known to the user e.g., standard for the given platform
- Will the user choose that action?
- Is there a comprehensible response?

# PREDICTIVE METHODS: HYBRID METHODS

# Heuristic walkthrough

- A hybrid of inspection and walkthrough
- **First pass:** sequence checking
  - tasks chosen to cover most of the artifact (not necessarily typical)
  - „focusing questions“ as in cognitive walkthrough
- **Second pass:** inspection
  - check all elements utilized in the tasks for heuristic criteria
- Might need a finished artifact (not a prototype)

# Pluralistic walkthrough

- A hybrid of predictive methods and creative group techniques
- The principle:
  - A group of **users** interacts with a group of **designers**
  - The interaction is **facilitated/moderated** with a person whose sole interest is to **enable information exchange**
  - Similar to most group techniques, more on them later

# We need

- People
  - 6-10 users,
  - 6-10 developers,
  - 2-3 HCI/UX experts
  - a room (for A LOT OF PEOPLE)
- User tasks (as usual) – printed for each participants
- A mockup for each participant, that is, printed screenshots or panels, in the order of tested tasks

# We observe that

- Users are the primary participants
- The moderator controls information flow
  - discussion starts after all finished work
  - flipping to the next task has to wait for the moderator

# We do

- Explain the rules (moderator)
- Explain the artifact (developers)
- For each task
  - the moderator presents the task
  - all participants assume the role of a future user, decide and record the sequence (separately)
  - all participants discuss the result – the users have precedence, developers can explain reasons
  - the moderator tells the correct solution if necessary
  - the users fill a short questionnaire

# Predictive methods – a summary

- Based on user simulation
- Have logistic advantages
- Have relevance problems
- Two classes: inspections and walkthroughs
- Intermediate, combined methods possible

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# METHODS: INTERPRETATIVE

# Interpretative methods

- real users
- real tasks
- real artifact
- real environment
- real motivations

the goal:
understanding

**interpretive methods**

- hired users
- controlled tasks
- real artifact
- controlled environment

the goals:
checking,
understanding

**usability testing**

the goal:
measurement

**quantitative lab methods**

- users represented or simulated by experts
- controlled tasks
- a prototype

the goal:
checking, prediction

**expert evaluation predictive methods**

# Research methods – a reminder

- **Quantitative approach**
  - Measurable quantities (metrics)
  - Constant and reproducible circumstances
  - Statistically evaluated data
  - Easy evaluation
  - **Looks scientific**
  - **Can miss principles**
- **Qualitative approach**
  - A priori theories not useful
  - Naturally occurring circumstances required
  - No mechanical way to understanding
  - Understanding difficult to communicate
  - **Looks unreliable and un-scientific**
  - **Can discover real causes and principles**

# Interpretive methods

- Understanding → interpretation → **interpretive research**
- Focuses on **human activity**, not technology
- Prefers **understanding** to measurement
  - qualitative data
- Prefers **participating observation** to manipulation
  - real situation
- Lets the researched persons participate actively
  - communication, ethics

# Ethnographic methods

- **Borrowed from ethnography**
- Natural situation (context)
  - work
  - time
  - social
  - motivational
- „Inside view"
  - participation
  - no control over the situation
  - direct observation
  - interpreting the meaning
- Output: understanding
  - mostly qualitative
  - hard to communicate

# Participating observer

- Real situation, no control, direct observation, interpretation: **personal presence and engagement**
  - Pure observation, participation, querying in context – as needed
  - The best compromise between disturbance and ethical failure
  - Based on contact with the observed
  - Must convince the observed about the real role of the observer
  - Iterative approach, work hypotheses
  - „If it is clear to you what happens next, you understand the situation“

# Output communication

- Understanding is **hard to communicate**
  - no report suffices
  - stories are not representative enough
  - an understanding description, without value judging
- **Possible solutions:** the observer
  - as a team decision helper
  - as a user representative
  - as a simulating expert

# Modifications

- **Preliminary research** (“Quick and Dirty”)
  - getting the context
- **Rapid Ethnography** – with cautions
  - short time: no time to develop relationships and empathy
  - key informers: who is that is a question of the research
  - limited scope: may miss principal moments
  - multiple observers: mutual communication questionalble

# Role in design

- Formative phase (Concurrent Ethnography)
  - key informations for design, important part of context analysis
  - an important link between users and designers
  - long time
- Summative phase (Evaluative Ethnography)
  - final evaluation
  - confirms theories, design principles
  - danger of bias and too narrow focus

# Understanding as a social tool

- A tool of change
  - whose profit?
- The observer as a link
  - between people and technology
  - so they shall act for the observed
  - which is difficult with all those mighty shareholders around

**THOU SHALL EXPLAIN**
**THY FINAL REPORT**
**TO THE PEOPLE**
**THOU HAVE OBSERVED**

# Interpretive methods – a summary

- Goal: understanding
- Real situation, users, tasks, motivation, social context
- Direct observation
- Participating observer:
  - open engagement
  - open aims
  - open purpose of the research
- Difficult communication of the output

# USABILITY TESTING

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# Usability testing

## and other lab methods

- real users
- real tasks
- real artifact
- real environment
- real motivations

the goal: understanding

**interpretive methods**

- hired users
- controlled tasks
- real artifact
- controlled environment

the goals: checking, understanding

**usability testing**

the goal: measurement

**quantitative lab methods**

- users represented or simulated by experts
- controlled tasks
- a prototype

the goal: checking, prediction

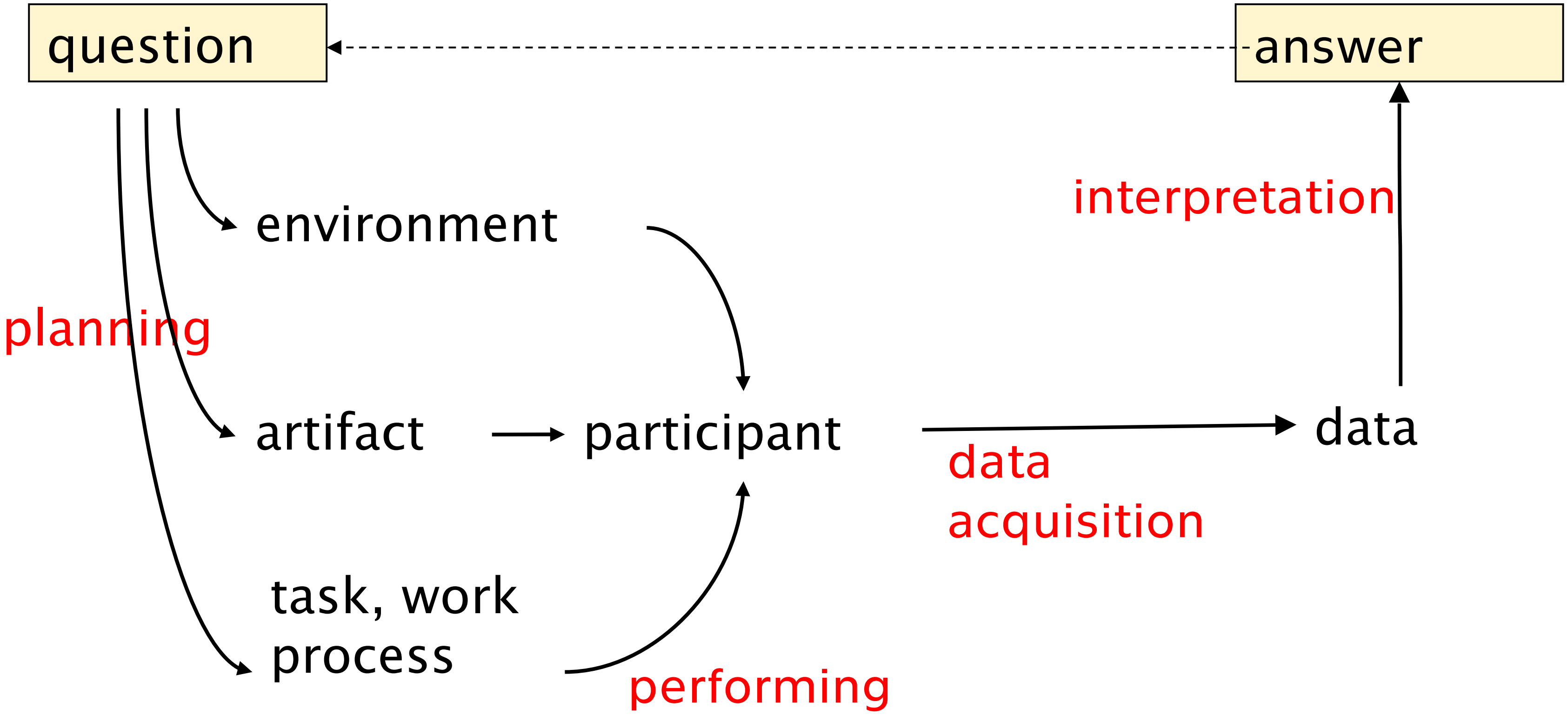
**expert evaluation predictive methods**

# THE PRINCIPLE

# Active evaluation: principle

- To answer questions using the outcome of **controlled events**
- To completely **plan** an event that would answer the question
- To let the event run in a controlled environment, while **observing** and **collecting data**
- To interpret (extrapolate, generalize) the data to answer the question

# Active evaluation



# Usability testing

- Observing and recording the actions of **test participants** (testers), who perform **set tasks** in a **controlled environment**
- **Controlled environment:** as required by the questions
  - therefore, in a usability lab
- **Tasks:** as required by the questions of the tests
  - typical (from user research). covering the tested parts, suitable for verification of a hypothesis
- **Test participants:** as required by the questions
  - often: by personae
- **Output:** a list of **problematic situations** – qualitative

# THE USABILITY LAB

## ARRANGEMENT

## PEOPLE

## FUNCTIONS

# Usability lab: what is it for

- **To prepare the testers** for the event:
  - needs space for questionnaires,
  - needs room for introductions, explanations
- **To set up the event:**
  - to provide room for artifacts, tester workplaces,
  - to mimic the environment for the task,
  - to permit a moderator to guide through tests
- **To collect data:**
  - to permit more people to **observe**, without disturbing the participant,
  - to enable easy audio/video and other event monitoring,
  - to provide room for debriefings, media postproduction etc.

# Usability lab: arrangement

- **Participant room** (observation room)
  - where the event takes place
- **Control room**
  - where the observation and recording takes place
- **Other spaces**
- **Examples**
  - TECED
  - Noldus

# The participant room

- Looks **convenient and friendly** unless requested otherwise
- Has a tester's place(s), is **flexible** to mimic a real situation
  - Frequently, just a chair and a table with a PC
  - Testing mobile apps: shall the user stand? walk? use both hands?
- Has a **moderator's place:** close enough to the tester to see what happens, not close enough to be unpleasant
- Allows **monitoring**
  - wall cameras (remote pan, tilt, zoom), mobile cameras
  - fixed and mobile microphones (omnidirectional in the room, unidirectional for the participant)
  - artifact monitoring (screen, events)
- Allows **communication** from the control room

# The participant room

# The control room

- **Observation space** – observers, experts
  - multiple observers
  - recording aids
- **AV processing and recording** – technicians
  - camera controls:image tiling, monitor control
  - audio mix
- Connections with the **participant room**
  - One-way glass
  - AV reproduction, monitors, speakers (instead)
  - Intercom – PA and/or moderator's earplug
- Wall clock

# The control room

# Other spaces

- Test supervision and management – test monitor
  - in large labs, a separate room
  - the overall monitoring and supervision of tests
- Preparation room(s)
- Debriefing room – post-test debriefing, interviews, etc.
- AV postprocessing and archival – ideally, performed while other tests run

# USABILITY TESTING: THE PLAN

# Usability testing: input

- The **question** and the **role** of the test
  - **a preliminary test** during design
  - a test to understand existing problems
  - **a formative test** – problems with previous versions, etc.
  - **a summative test**
- From **context and task analysis**:
  - for whom – personas
  - for what – domain tasks, procedures
  - where – social, technical context, environment
- From **design:**
  - the artifact – mostly complete
  - questions and assumptions from design

# Usability testing: the plan

- How to **select** testers: number, characteristics, questionnaires
- How to **prepare** testers: instructions, training
- What **tasks** to set
- What **environment** to set

  What **moderator's** instructions
- What **data acquisition**: camera positions, data monitoring, etc.
- What after the test: **debriefing**, questionnaire?
- What data **interpretation** methods: qualitative, partly quantitative

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# Planning: participants

- **Their profile**
  - for a preliminary test: anyone we meet except designers and engineers (hallway testing)
  - for a precision summative test: by personae, verified by a pre-test questionnaire (screener)
- **Their number**
  - the number of discovered mistakes grows slower than the number of participants;
  - having 10 participants, it is better:
    - to test with 5 participants
    - to correct the mistakes
    - to test again with another 5 participants

# Planning: preparation

- **Consents** needed?
  - general testers' rights
  - eyetracking
- **Their skills?**
  - anything we do not know from our database and have to ask
- **Their preparation:** what they shall know before the test?
  - do we test an initial familiarization with the artifact?
  - do we test a routine usage of the artifact?
  - do we expect professional usage with training, etc.?
  - is the artifact for casual use?

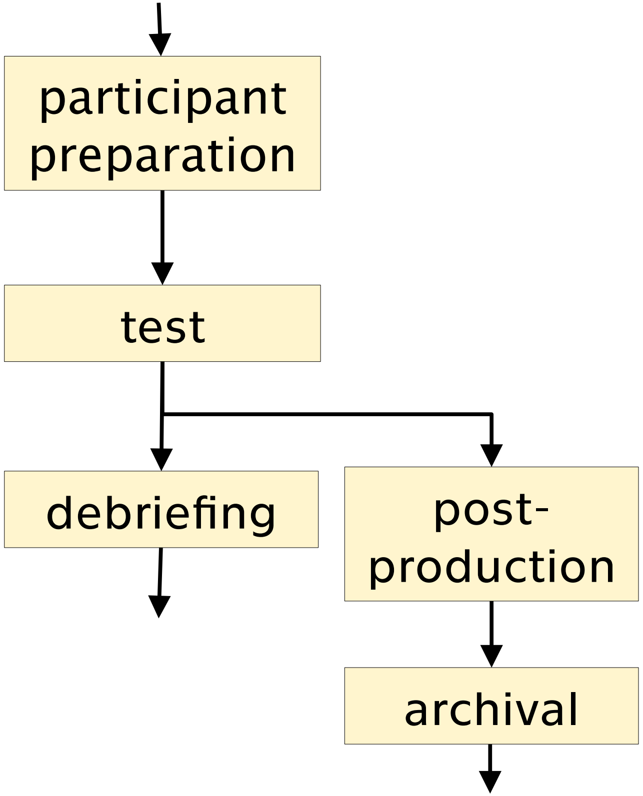
# Planning: the tasks

- In a **preliminary** test, aimed at
  - artifact coverage
  - key actions
- In a **final summative** test, representative tasks
  - from user research,
  - from early feedback,
  - from field studies
- Not more, it is costly

# Planning: execution

- **Environment, equipment**
  - what shall be at the participant place
  - what shall be installed, and in what state
  - how to return to that state before each test
- **The role of test moderator**
  - what to explain to the participant before each task
  - how much aid can/shall be provided
- **The data collected**
  - channels, focus
- **Final report format**

# Planning: logistics




- Participants recruitment
  - collaborating users
  - a database of collaborating people
  - observe who tested what and how often
- Pipeline
  - separate teams for separate phases
  - separate space
  - beware of logistics: if you want the moderator at the debriefing, you shall have more of them

# USABILITY TESTING: THE TEST

# First phase: participants

- Hire people **representing** the target groups from the formative phase
  - depends on scale, purpose, etc.
- **Verify** if the representation is good enough
  - a **questionnaire** aimed at characteristics that are important for the test
  - it screens the test from inappropriate testers, hence the term **screener**
- **Prepare** the testers
  - explain the **purpose** of the test
  - recite the **disclaimer** (anyone is free to leave, confidentiality…)
  - if required, **explain** the artifact
  - if required, **train** the testers to use the artifact

# The test: the participant room

- Introduce the tester into participant room
- The moderator introduces herself
- For each step (task)
  - the moderator **explains** what is to be done
  - the tester tries to **perform** the task
  - the moderator **may guide** the user, e.g., reminds her of things to be done
  - the moderator **intervenes** if necessary (e.g., dead ends), tries to keep the test running
  - can **ask** what the problem is
- Final thanks, further instructions
  - e.g., go to the debriefing

# The test: the control room

- **Observers**: observe the tester
  - **observe** facial expressions, movements, etc.
  - **record** with synchronized time, on paper or by electronic means
- **Technicians:** perform data collection
  - change camera aims and zoom
  - care about all recordings (e.g., sound level)
- **Test supervisor:** keep the large picture
  - keep everything running
  - observe whether the test is going to answer the question
  - observe and record surprises
  - record lessons learned for the next test
- **Developers:** learn

# After the test: participants

- The purpose: **a look from inside**
  - observations, recording, etc.: from outside
  - thoughts, feelings, hypotheses, answers to the moderator: from inside
- A **questionnaire** asking for:
  - subjective evaluation,
  - task hardness, etc.
- or: a **post-test debriefing**
  - aimed at failed tasks, observed difficulties
  - logistics: what were they?
  - possibly, the moderator participates

# Interpretation

- The data describe what happened during **this particular event**
- The final answer is something about the artifact **in general**
- The kind of interpretation follows the question
  - qualitative – understanding
  - quantitative – auxiliary
- Based on consolidated data
  - timestamps, synchronized
  - merged observation logs

# Qualitative interpretation

- Identify **tasks** that did not meet criteria
  - failed, negative comments
  - a fast scan of consolidated data
- Identify **errors**
  - which part of the process did fail?
  - what has the moderator to rectify?
  - what was the **kind** of the error: loss of orientation, status visibility, terminology problem?

# Qualitative interpretation

- Analyze the **causes**
  - start with observation logs, identify **time**
  - the AV recording **at that time** tells what the tester **did** and what their **body language** tells
  - the monitoring log tells what did happen in the application
  - speaking aloud tells what the testers thought they were doing
  - eye tracking tells what the testers saw (or failed to see) and what they saw but did not recognize

# A bridge to quantitative methods

- **Why?**
  - artifact comparison  for large-scale purchase
  - artifact comparison for review (magazines etc.)
  - development control (usability engineering)
- **How?** Metrics
  - **effectiveness:** tasks completed, time needed, error rate
  - **satisfaction:** numerical scales (questionnaires etc.)
  - **user interface disasters:** simple but effective
- **Modifications** to the basic method
  - more testers (statistically significant, ~25)
  - no moderator, no intervention

# Finally(!): report

„The single most important thing is not the research, but the paperwork!“
*Michal Z. Servít , discussing management of international research projects*

- For the target group of the report, the findings must be
  - comprehensible
  - trustworthy
- Who is the target group?
  - team colleagues
  - developers (in a small large organization)
  - customers
- An example of a template

# DATA ACQUISITION METHODS

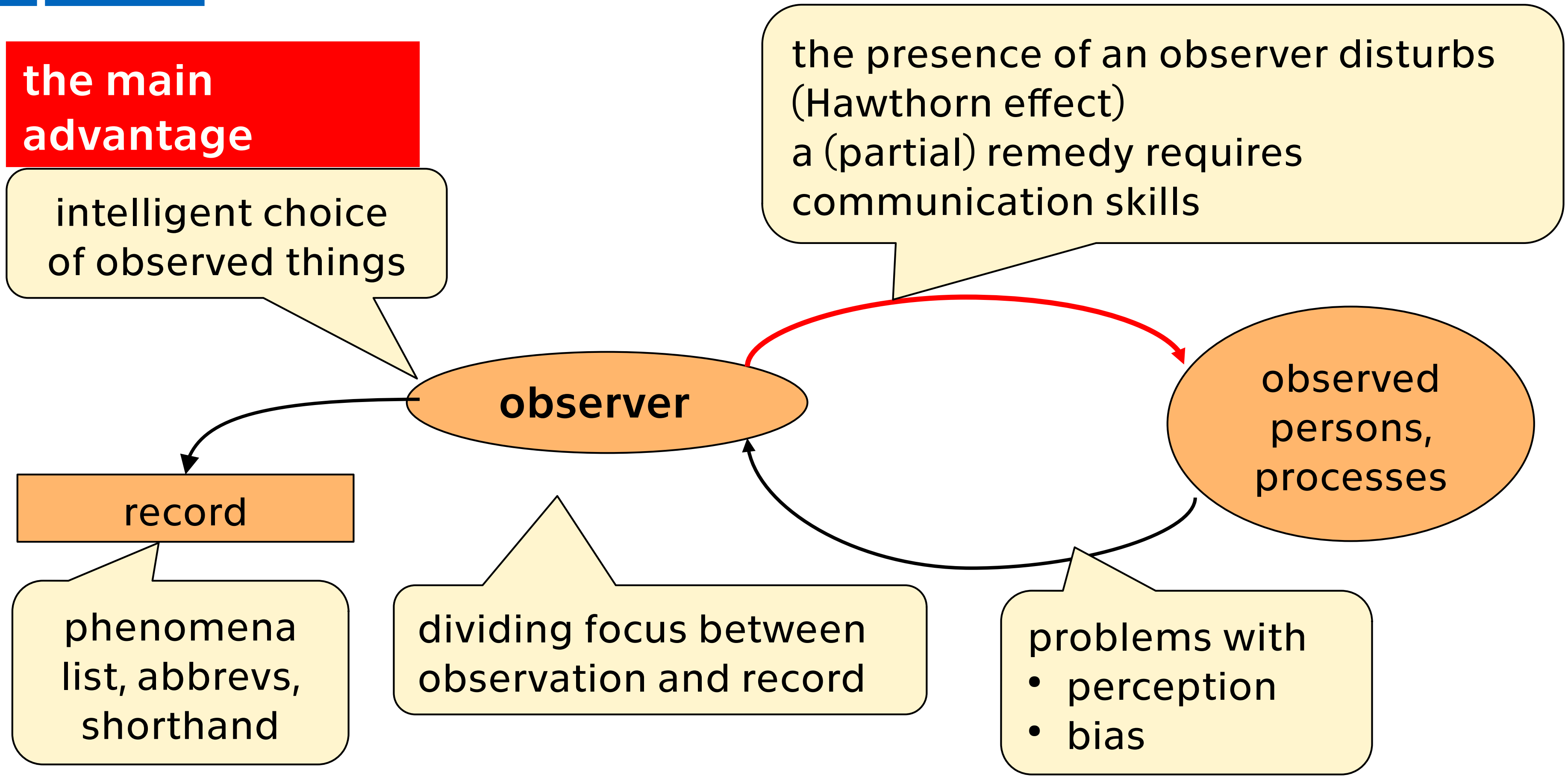
OBSERVATION

AV RECORDING

MONITORING

VERBAL METHODS

# Direct observation



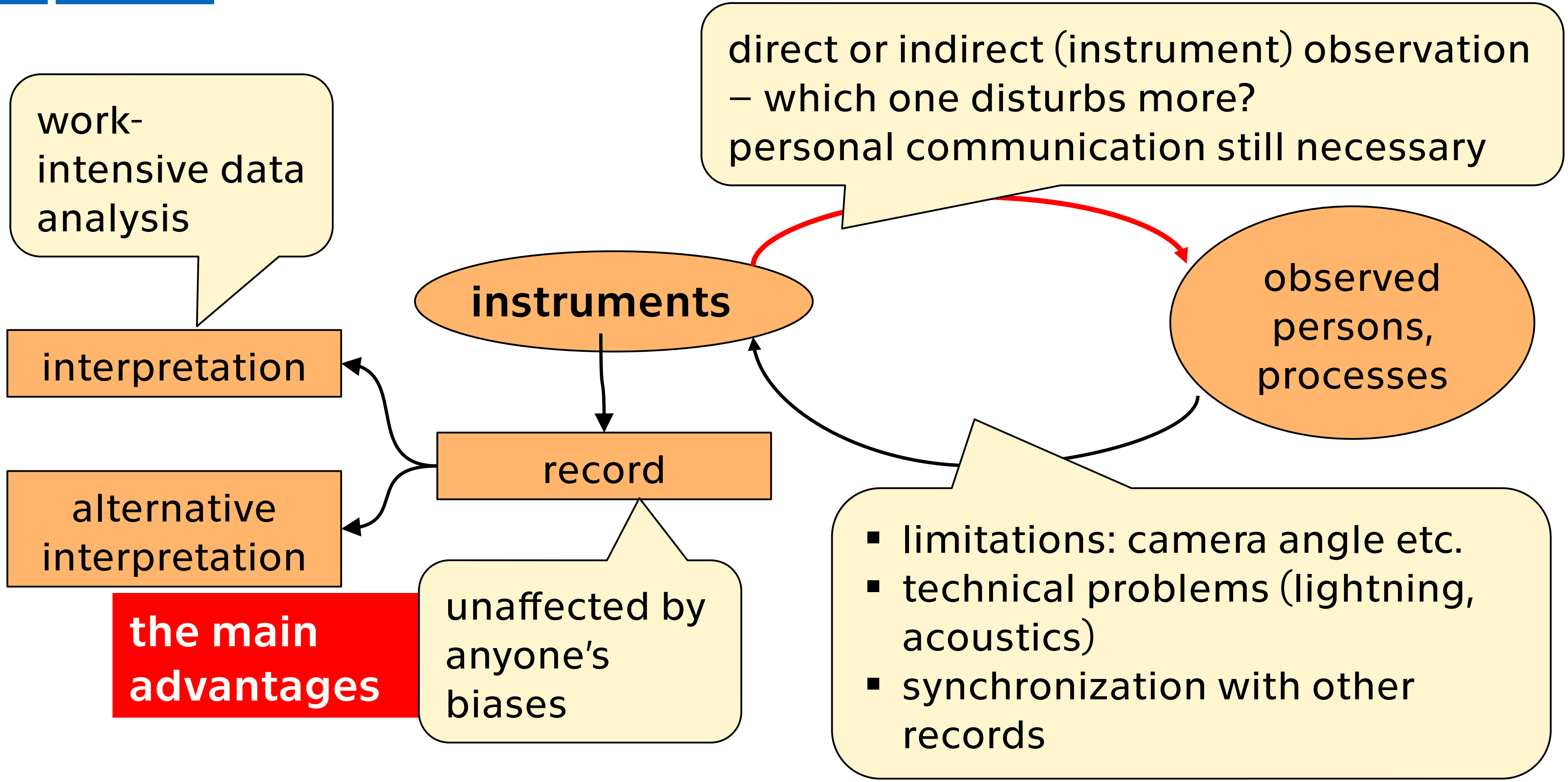
- Direct observation means the personal presence of an observer in the situation.
  - This is a major advantage, as we have an intelligent agent on the spot, who can choose what is important to observe.
  - The presence of the observer modifies (disturbs) the situation, so that the observer should have communication skills to ease the situation
  - The observer should not have any bias wrt. the situation
- The observer records what is observed during observation.
  - The observer has to divide focus between observation and recording
  - Therefore, various tools are used (shorthand, predefined symbols for frequent actions, etc.)

# Why direct observation?

Ninety-five percent of the stumbling blocks are found by watching the body language of the users. Watch for squinting eyes, hunched shoulders, shaking heads, and deep, heart-felt sighs. When a user hits a snag, he will assume it is "on account of he is not too bright": he will not report it; he will hide it … Do not make assumptions about why a user became confused. Ask him. You will often be surprised to learn what the user thought the program was doing at the time he got lost.

- **Meyers, Joe; Tognazzini, Bruce** (1982). Apple IIe Design Guidelines
  - „body language“
  - participant pretention
  - inside view
  - mental model

# Audiovisual recording

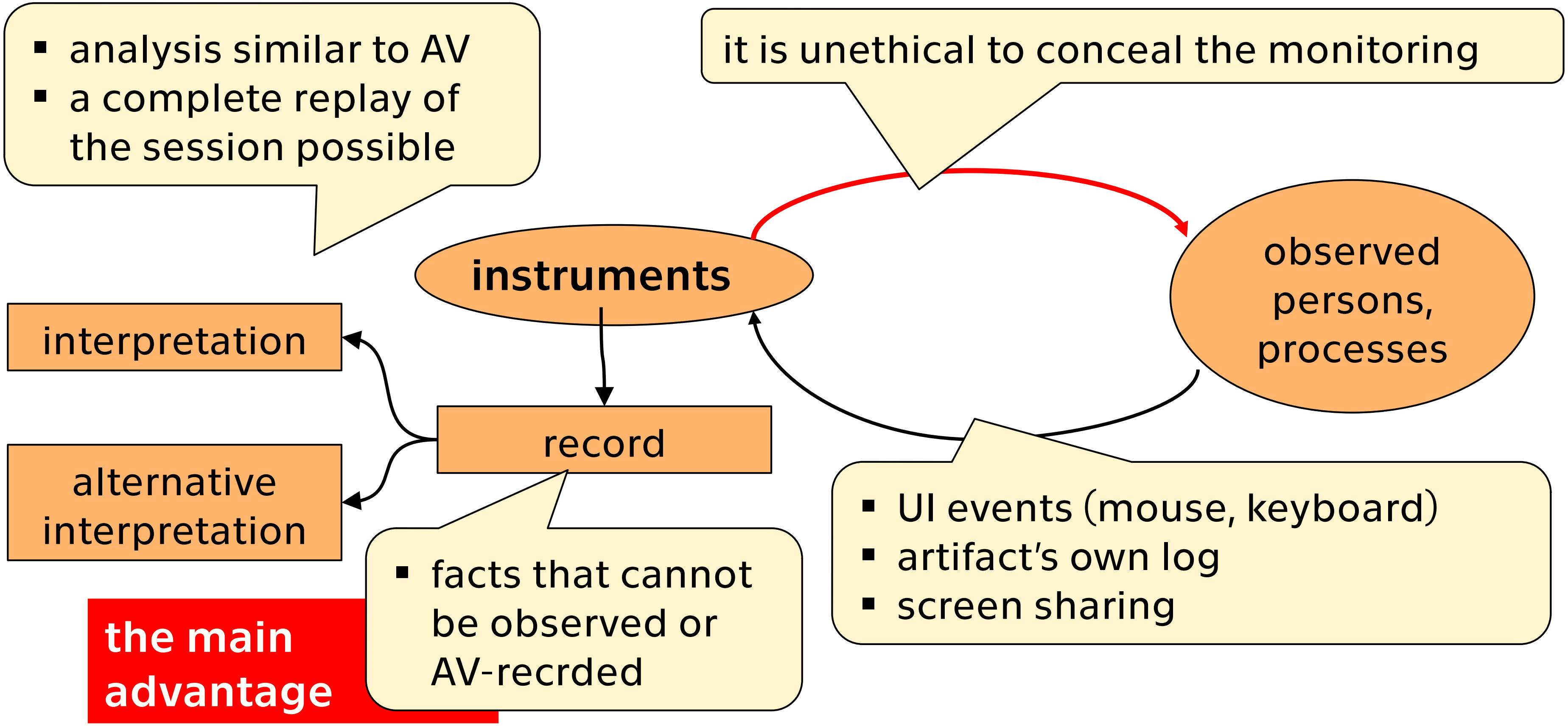


- The AV equipment produces permanent records, which can be archived.
  - The information is not likely influenced by anyone's personal bias.
  - To interpret the records, much effort is needed
  - However, alternative interpretations are possible, and that is the principal advantage of this method.
- Technical obstacles must be overcome:
  - camera positions which do not disturb but produce useful views
  - microphone techniques insensitive to room acoustics, tester movements, low volume speech, etc.

# Doing AV

- **Planning: what do want to see** for the evaluation?
  - mostly, **facial expressions**
  - **physical actions** – e.g. printer unpacking test, cockpit ergonomy
  - fixed positions or preset camera settings, scenarios
- **Performing**
  - in stationary labs, at least one technician, scenarios
- Demanding **evaluation**:
  - **1 hour of recording = 6 hours of analysis**
  - plan well, have minimum footage
  - analyze only moments that the observers think are important
- **Postprocessing** and **archival** – for future interpretations

# Monitoring



analysis similar to AV
a complete replay of the session possible
it is unethical to conceal the monitoring
instruments
observed persons, processes
interpretation
record
alternative interpretation
UI events (mouse, keyboard)
artifact's own log
screen sharing
facts that cannot be observed or AV-recrded
the main advantage

# Verbal methods

- **Principal advantage:** a view **"from inside"** – complementary to observation etc.
- **Task-related** words, speech
  - Natural speech, commonly, a dialogue of two users
  - Used also in the formative phase (real user terminology,...)
- **Speaking aloud**
  - during test, testers verbalize their own actions
  - a problem: additional load
- **Post-test debriefing**
  - interview about difficult/unsuccessful moments in the test
  - problems: rationalization, i.e. trying to explain erroneous actions by rational arguments

# Eyetracking

- **Technical principle:** analysis of the eye image using reflection of infrared light
- **Eye movements:**
  - Fixations: a look at a single location, long enough to recognize what is there
  - Saccades: rapid movement between fixations
- **Gives**
  - Eye movement recordings - **qualitative**
  - Eye movement maps – **qualitative**
  - Heat maps (fixations frequency in space) – **quantitative**
- **Needs**
  - Calibration and recalibration for each tester
  - Frequent interventions to keep calibration
  - Special agreement from the tester

# VARIANTS OF USABILITY TESTING

# Remote usability testing

- In principle identical, but over communication channels:
  - **Synchronous - in real time,** using videoconferencing and collaborative software
  - **Asynchronous – file sharing, messages, etc. - preparations, tasks, questionnaires: all online,** upload support for monitored data, logs, …
- Which channels synchronously (screen, face…) and asynchronously (logs, monitoring)
- Properties
  - Natural environment, less distraction
  - Without personal contact and observation,
  - Harder to find “why”

# Simplified versions

> Our testing method is as follows. We set up a room with five to six computer systems. We schedule two to three groups of five to six users at a time to try out the systems (often without their knowing that it is the software rather than the system that we are testing). We have two of the designers in the room. Any fewer, and they miss a lot of what is going on. Any more and the users feel as though there is always someone breathing down their necks.

- **Meyers, Joe; Tognazzini, Bruce** (1982). Apple IIe Design Guidelines
  - very early – before the HCI era started
  - without separate rooms
  - problems: disturbance and observer receptiveness
  - **however it did (and does) work**

# Mobile labs

- Recording equipment gets miniaturized
- Digital technology enables to put mixers, converters, editors into software – in a portable machine
- IP techniques work with off-the-shelf components
- The results can be put into a carry-on case and used even in a driver's cab
- Example: nngroup mobile lab


NN/g
Nielsen Norman Group
TUESDAY 14 AUGUST
TANNER ROOM
PLEASE DO NOT
DISTURB
RECORDING IN
SESSION

# Mobile eyetracking

- Example:
  - nngroup mobile eyetracking
- Setting:
  - Everything is running on a single (powerful) machine
  - Everything is controlled (served, maintained, ...) by the moderator
  - Eye traces on the moderator's monitor in real time
  - Calibration – limiting tester's motions – fixed chair
  - Intervention during test: recalibration, handing documents to the tester
  - Many chores for the moderator – little or no time for observation and recording

# Conclusion

**No Excuses**
No equipment? That's no excuse for not testing your design.
[...]
No usability lab? Not an excuse either.
As I've shown here, you can test almost anywhere, in any country (including your own!), with a small amount of equipment that you can either scavenge on site or bring in a carry-on bag. The one thing you do need, however, is real users who represent the target audience.

- Jakob Nielsen: Traveling usability lab (2012)

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# PSYCHOLOGICAL ASPECTS AND HUMAN INTERFACE GUIDELINES


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# HUMAN INTERFACE GUIDELINES

# HIGs

- Platform standards
- For all platforms,e.g., MacOS, iOS, … , KDE, GNOME, … MS Windows, etc.
- Exact contents varies
  - interface elements and rules for their usage – always
  - visual patterns
  - navigation patterns
  - technologies
  - manifestos on attitude to users and on graphical appearance
  - best practices, etc.

# Android

- Overview App quality guidelines: inspection enhanced with tests
- Material Design „**Bold, graphic, intentional**
- Material Design is guided by print design methods — **typography, grids, space, scale, color,** and imagery — to create **hierarchy, meaning, and focus** that immerse viewers in the experience." [emphasis J.S.]
- Icons
- Including Dynamic Color "Hierarchical: Color indicates which elements **are interactive**, how they relate to other elements, and their level of prominence. Important elements should stand out the most." "Expressive: Show **brand** colors **at memorable moments** that reinforce your brand's style."[emphasis J.S.]
- The Crane ExampleColor systemColor system

# Human Interface Guidelines

- Apple
- Microsoft Fluent Design System
  “Calm. Windows 11 is softer and decluttered; it fades into the background to help me stay calm and focused. The experience feels **warm**, **ethereal** and **approachable**.“ [emphasis J.S.]
- KDE design vision, empowering, pleasure
- Gnome
  Reduce User Effort.
  It is our job as software creators to reduce the amount of work and effort that people have to expend. This often means **anticipating** user needs, which requires **having insight** into the kind of situations and people your app is for. [emphasis J.S.]

# Graphic language and consistency

- Android: gestures list
- Apple: element „dictionary“
- Microsoft: Win32 element „dictionary“
- Microsoft: Win32, radius
  Starting with version 2.2 of the Windows UI Library (WinUI), the default style for many controls has been updated to use rounded corners. These new styles are intended to evoke **warmth** and **trust**, and make the UI easier for users to visually process.
- Microsoft: Win32, what is a button

# Grouping

- Microsoft: visual hierarchy and reading patterns
- Microsoft: the role of depth and shadow
- Microsoft: grouping methods

# Functions, style, manifestos

- Apple macOS → Icons and Images → App Icons
  macOS – iOS differences
  https://developer.apple.com/design/human-interface-guidelines/macos/icons-and-images/app-icon/

- UX Guide → Guidelines → Visuals → Icons → Design Principles (Aero)
  https://docs.microsoft.com/en-us/windows/desktop/uxguide/vis-icons

# Personality and consistency

- Microsoft
  - Windows → Desktop Windows Desktop Apps → Design Guidelines → Experiences → Software Branding https://docs.microsoft.com/en-us/windows/desktop/uxguide/exper-branding
- Apple OS X → User Experience Guidelines → Brand Appropriately https://developer.apple.com/design/human-interface-guidelines/ios/visual-design/branding/

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# USABILITY AND LOVE

# Antropomorphic machines

- A machine is just a machine.  To treat it as human (antropomorphization) is misleading.

*Common HCI stance*

- Pushing past “neutral” UX design to “delightful” design can break down barriers and get a product to the point that a user has an emotional relationship with the product. "

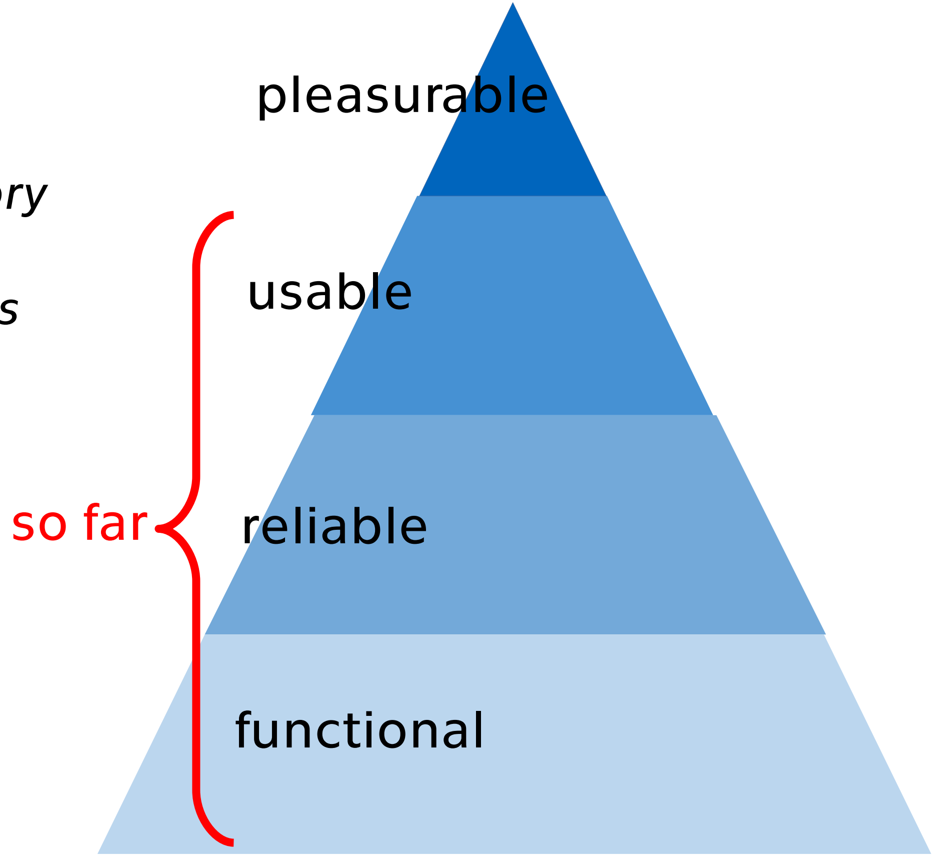
*Steve, Detroit Labs, 2019*

- And that's something that we do with everything. We assign, we anthropomorphize things all the time. We always give humanity to things as we observe them in the world. So why don't we try to give some humanity to our products and services that we create because users are going to be doing that anyway. So we can try to control that."

*Steve, Detroit Labs, 2019*

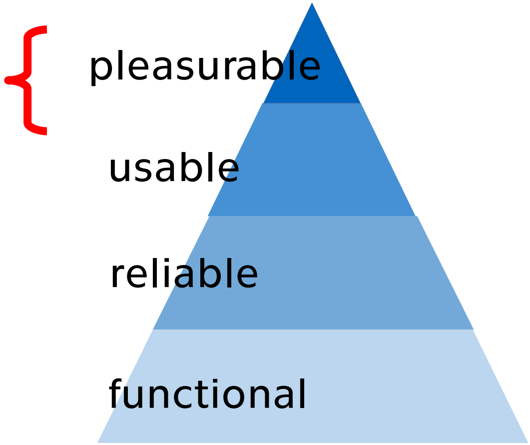
# User's needs

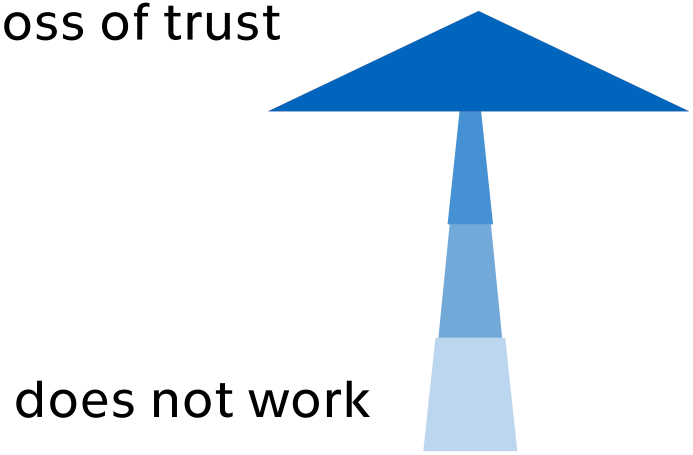
- Aarron Walter, *Designing for Emotion*
- Therese Fessenden, NNGroup, *A Theory of User Delight: Why Usability Is the Foundation for Delightful Experiences*



# Surface delight

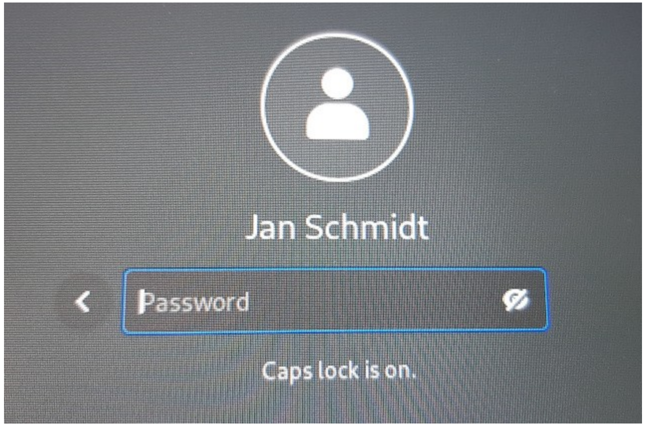
- Local, contextual
- Examples:
  - animation, sound response, illustrations
  - easter eggs – unexpected response, microcontent
- Surface delight **only**: loss of authenticity, loss of trust



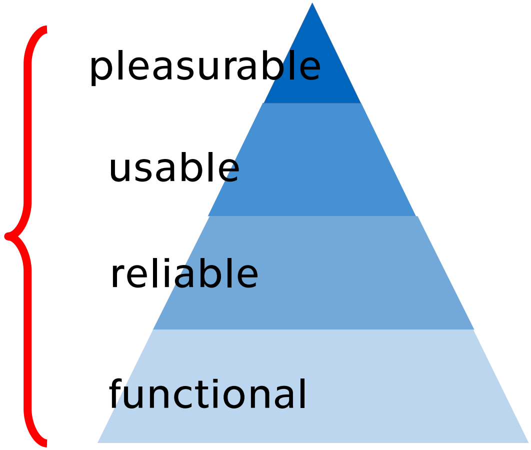
# Surface delight


- If the password entered is incorrect, the text area shakes, as a human shakes her head to say ‚nay'
- Amusing, polite, easy to understand




- However, this is by far more useful

# Deep delight




- All needs satisfied: functionality, reliability, usability, pleasure
- An experience of smooth and effective collaboration
- An experience of safe and efficient exploration
- Inconspicuous but efficient
- Often a reason to recommend

# Design aims

- **To achieve user/stakeholders goals** (web: conversion driven)
  - emphasis on functionality and usability
  - user delight from successful, fast and accurate achievement
- **To induce positive emotions**
  - emphasis on pleasurability
  - user delight from  harmony

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# „Building blocks“ of emotional relation

*Don Norman ,*
*“Emotional Design: Why We Love (Or Hate) Everyday Things”*

- Visceral
  - without much thinking
  - first impression
- Behavioral
  - function, collaboration, usefulness
- Reflexive
  - rational evaluation
  - connotations (cf. later)
  - social acceptability
  - targeted by promotion and branding

# Negative bias

- Any **negative** experience is a reason to **change behavior**
- Therefore, it is **remembered more**
    - many actors remember their negative reviews better
- A negative experience has a **bigger impact** than a positive experience
- A negative experience at the behavioral level **destroys** positive experience at the visceral and reflexive levels → stops exploration

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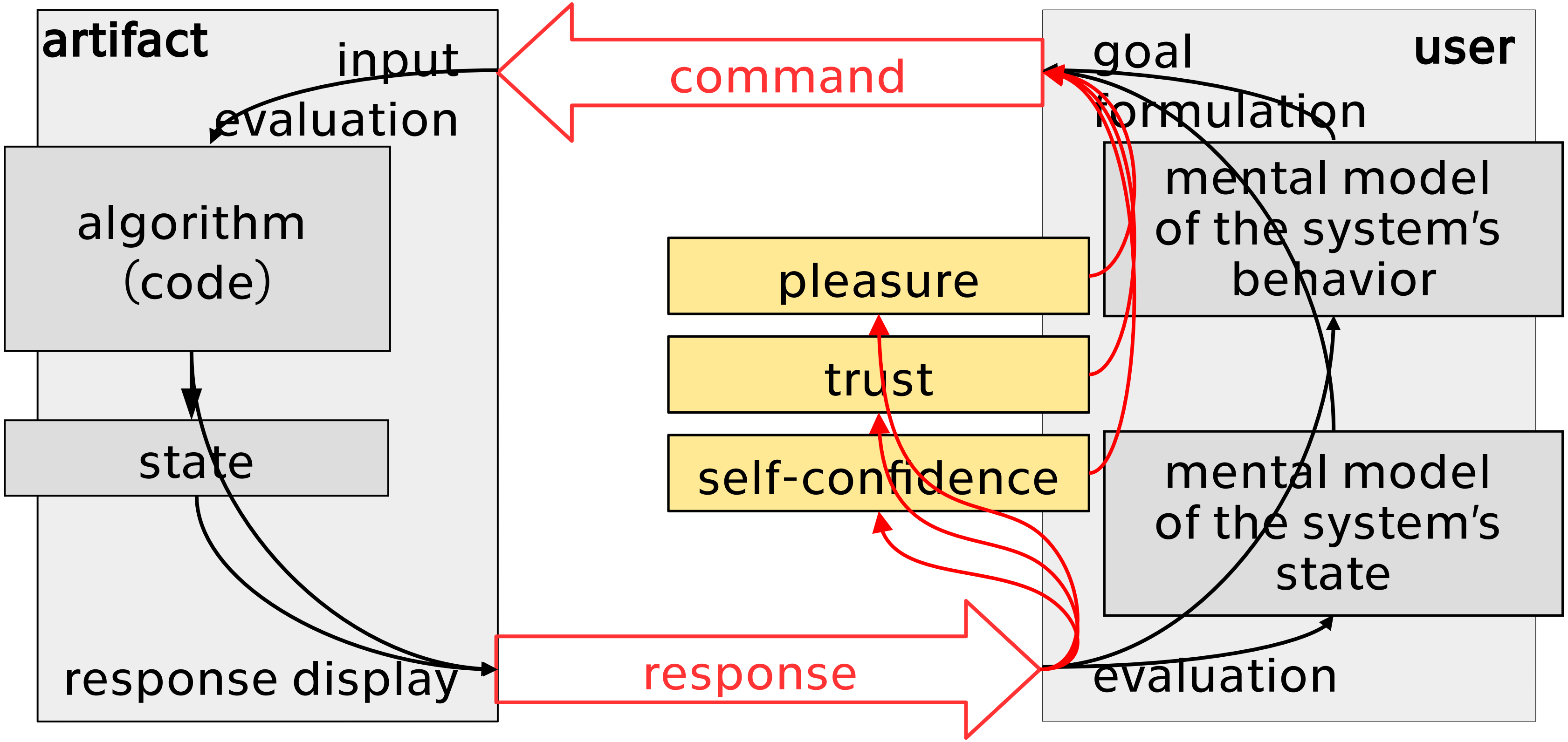
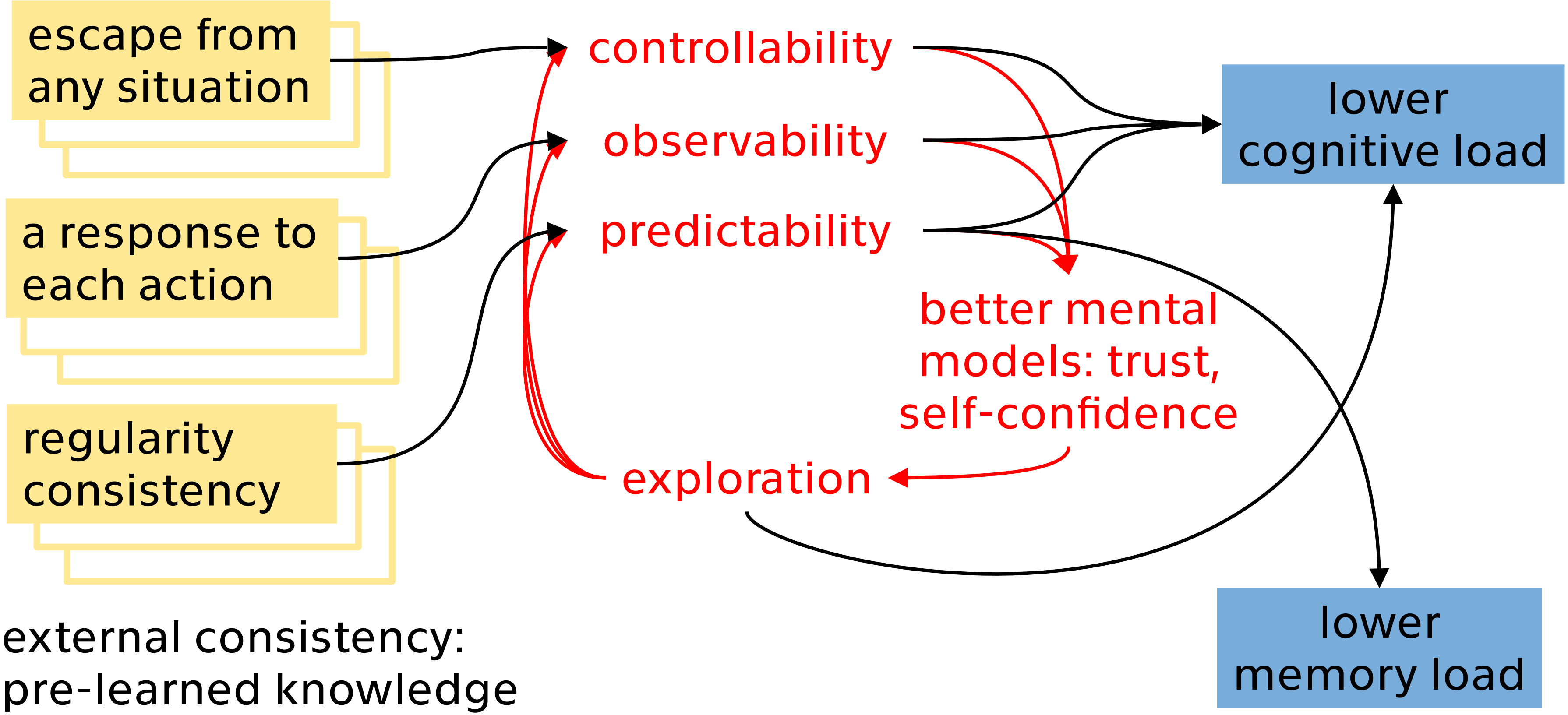
# DELIGHT IN EXPLORATION

# Interaction as a closed loop

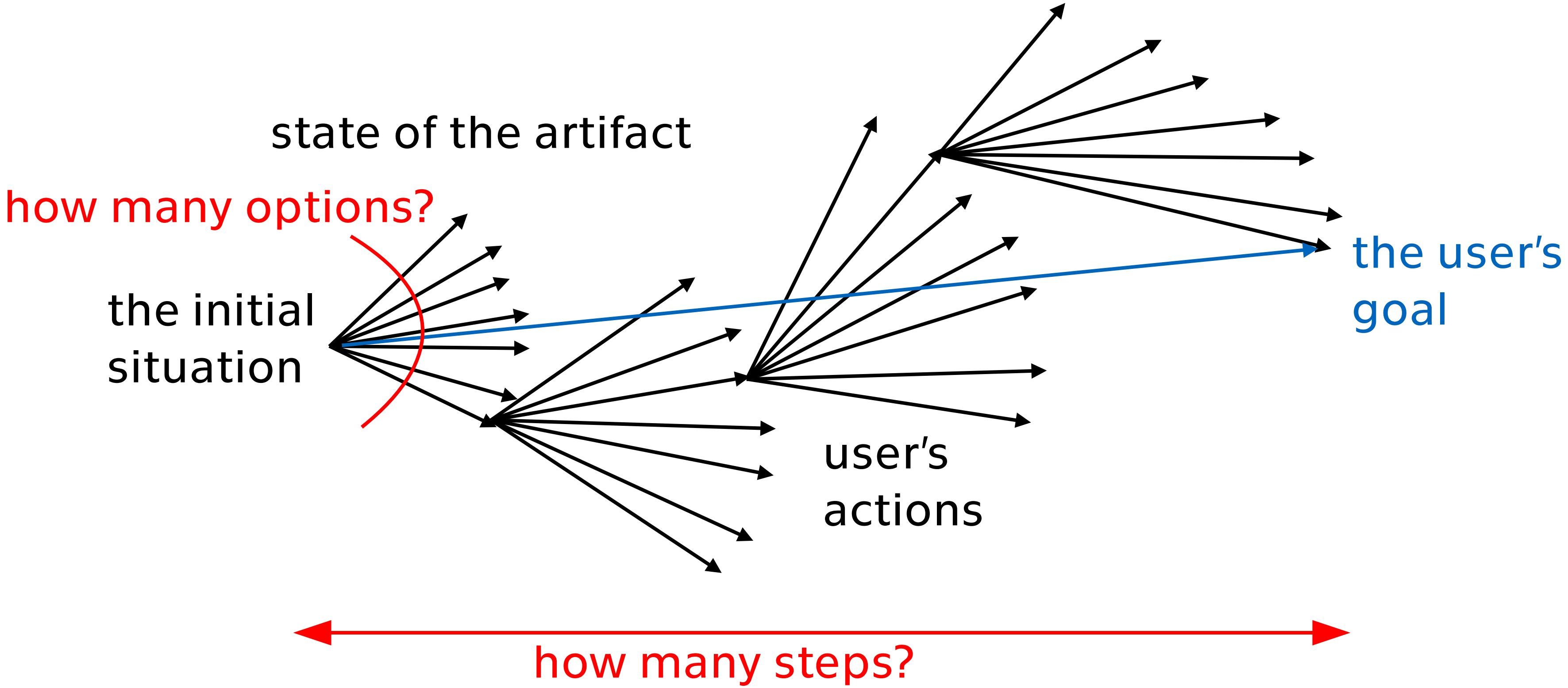



**Self-confidence is the trust in one's mental models**

# Exploration



# User interaction
## and the granularity problem again



# Hick's law

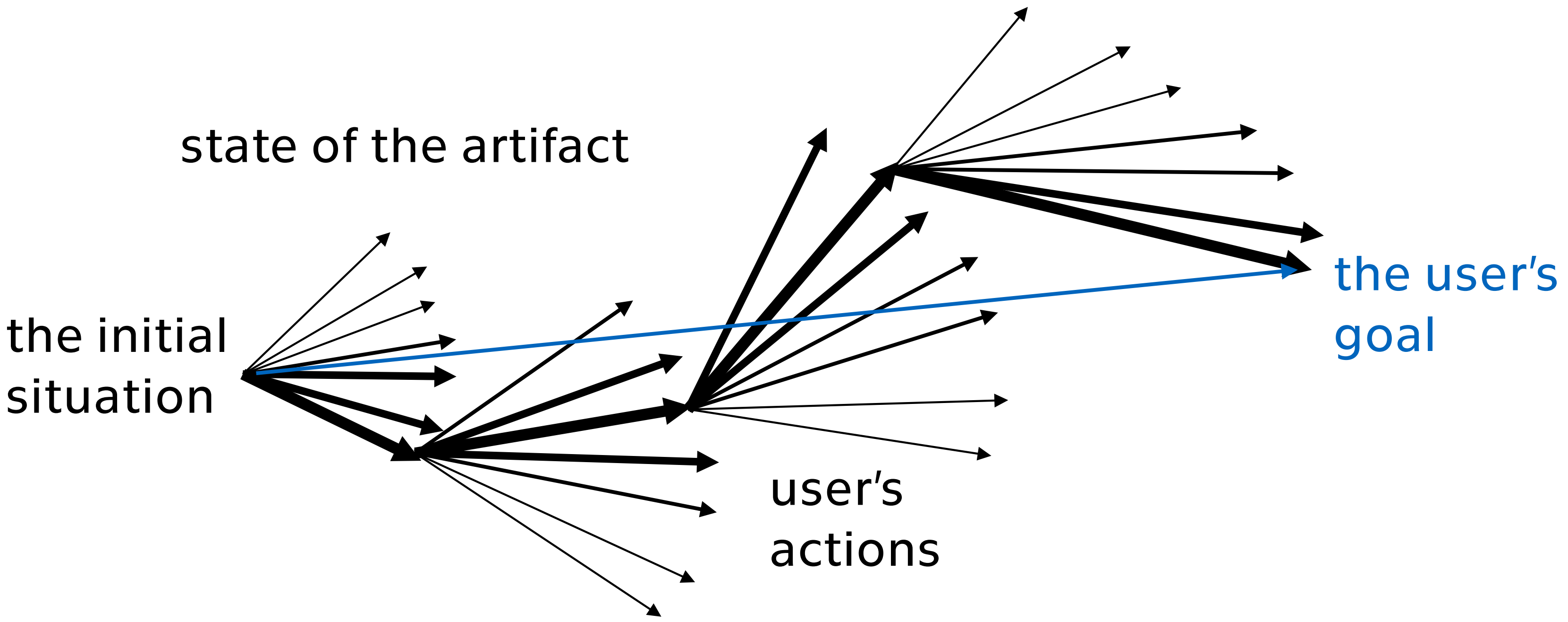
The expected user reaction time $T$ to a stimulus is $T = a + b \log_2 n$, where

- $n$ is the number of options
- $a, b$ are calibration constants, dependent on
  - user
  - task
  - other context

except when the user has decided prior to stimulus arrival.

- K.I.S.S. - Keep It Simple, Stupid
- Less options per step → more steps
- Optimization: option prioritization

# Prioritization



# Prioritization methods

- By visual **ordering** – see techniques for attracting and guiding attention
  - in the order of expected use frequency
  - in the order of other stakeholders preferences
- By estimated **information scent**, in turn given by
  - what the user sees at the moment
  - what the user already knows about the action or information source

# Information scent

- What the user **sees**
  - **a label** (link, text, name, …): is it lexically related to the goal? → domain analysis → categorization
  - **nearby content:** a summary of the linked info, relevant picture, graphics
  - **context:** what does it mean w.r.t. the goal – a definition? an explanation?  an example? a business offer? a request?
- What the user **knows**: experience with
  - the given environment (app), brand
  - the current domain, arrangement, hierarchy

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*Robert B. Cialdini,*
*Influence: Science and Practice.*

# INFLUENCE AND PERSUASION

- **HONEST PERSUASION OR IMMORAL MANIPULATION?**
- **TOOLS AND METHODS**
  - **RECIPROCATION**
  - **CONSISTENCY**
  - **SOCIAL ARGUMENT**
  - **LIKING**
  - **AUTHORITY**
  - **SCARCITY**

# Reciprocation

- Provide something useful and valued prior to asking (e.g. data)
- Ask for information in a situation where the purpose of the request and a mental model of the app is clear;
- E.g., ask to read instructions when the need is clear

# Consistency and commitment

- The user wants to be consistent with her prior commitment or actions, **which may be used to affect future behavior.**
- *“So when I wrote that review already, I can register to have it uploaded”*
- Based on **trust** from previous interactions

# Social argument

- The user is affected by the **behavior of others**
  - *“everyone is in that queue to buy that new phone…“*
- Methods:
  - reviews
  - behavior examples – *“those who bought this bought also…“*
  - opinion – *“this (person) has xxx followers“*

# Social relations

- Connotations:
  - *we are people just like you,*
  - *yes, we are the people you are familiar with*
  - *we want to help (so that you like us),*
  - *we have the same values as you (so that you like us),*
  - *we praise you for your achievements (so that you like us, even if the praise does not look deserved).*
- Use:
  - humanizing the relations with IT,
  - building relationship with early adopters,
  - building long-term relationships.
  - etc.

# Authority and scarcity

- Authority: in domains, where e.g. professional certification can enhance credibility
- Scarcity:
  - *the last three …,*
  - *be the first who …,*
  - *limited to best sources only,*
  - *be better informed* (than everyone else), …
- **Fear from a loss is stronger than hope for gain** (Kahneman et al.).
- Use: value enhancement, conversion acceleration

# Summary

- HIGs: platform standards, vocabularies of the graphical language
- Pleasure and delight from interaction
  - surface delight: on top of the interaction
  - deep delight: from the entire interaction, needs all levels to work
- Pleasure from the sub-conscious to the rational: visceral, behavioral, reflexive – any negative experience kills all
- Influence: honest or immoral manipulation
  - several methods to use

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# INFORMATION ARCHITECTURE: NAVIGATION, USER SUPPORT

FIT ČVUT, KATEDRA ČÍSLICOVÉHO NÁVRHU

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2024

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# INFORMATION ARCHITECTURE: NAVIGATION, USER SUPPORT

- Content organization
  - structure
  - scheme
- Navigation components
- User support

# Search and navigation

- **Search:** selecting and finding **information content**
- **Navigation:** selecting and finding an **action**
  - Ubiquitous notion of interaction state: “where I am”
    → the notion of **place**
  - Navigation action: change state to another place
- Reasonably simple **mental model** required
  → simple **principles of organization**

# CONTENT ORGANIZATION

# Organization structure

- At each state of the interaction, **available targets** of navigation are structured **as a**
  - linear list,
  - multi-dimensional space,
  - record,
  - tree (hierarchy),
  - DAG (polyhierarchy),
  - general network, etc.
- The entire artifact can have **nested structures**
  - e.g., lists within a hierarchy

# Organization scheme

- The questions:
  - Does the structure have a **natural key**?
  - Is there a **single** natural key?
- Examples
  - Are all the items in a linear list artifact functions that can be chosen **by a name**?
  - Is it meaningful to arrange photos in a gallery **by time** (e.g., journey documentation)? → date?
  - Is it meaningful to arrange photos in a gallery **by places** pictured? → coordinates? → names?
  - Do the places themselves have a linear structure (e.g., railway documentation)?

# Exact organization schemata

- Natural ordering
  - alphabetical 1D
  - chronological 1D
  - geographical 2D
- Mutually exclusive
- Semantically **neutral** (e.g. the alphabetical ordering of authors' names)

# Subjective schemata

- Categories are not guaranteed to be mutually exclusive
- Categories depend on user, task, context
- By **topic** – from user's information needs
- By **task** – from user's goals
- By **audience** – by personas and related information; provided the user can easily identify with a category; needs traversing between categories
- By **metaphors** – e.g. waste bin

# Hybrids

- Simple mental model: organization by … into…
- More tan one relevant organization schema: a problem
  - Disclose them all
  - Make a hybrid
- **Hybrids**
  - are shorter
  - can be confusing

# Labels

That which we call a rose,
by any other word would smell as sweet.
*J.W. Shakespeare, Romeo and Juliet*

- Navigation and search are **indirect manipulation**
- Identification of items needs **names and labels**
- They belong to **naming scheme,** which forms an organization schema
- Categories need names
  - such that that users are able to find the correct category of the searched item
- A general problem of **categorization**

# Hierarchical structures
## quantitative aspects

- Dimensions
  - **Width**: the number of subcategories at a level; the number of items visible at the same time e.g., the length of a menu
  - **Height**: the number of clicks to reach a leaf
- Total size: width $\times$height $\times$ the number of hierarchies (if needed)
- When each item/subcategory is **in exactly one category:**
  - simple hierarchy
  - the organization structure is a directed tree
- When some items/subcategories are **in more than one category:**
  - polyhierarchy
  - the organization structure is a directed acyclic graph (DAG)

# Broad and flat hierarchies

- More specific category names – better **information scent**
- Less steps to a leaf/final content – better discoverability
- Longer menu – increasing interaction cost
- Danger of overlapping categories – polyhierarchy, esp. when the labels belong to multiple naming schemes

# Deep and narrow hierarchies

- Very general category names at the top level – may be missing in mental models
- More clicks required – but it is only a part of interaction cost
- Complex tasks are expected to have more clicks
- Thinking about a click can have bigger interaction cost than the click itself
- Some remedies: shortcuts etc.

# Beyond a single dimension

- Each dimension (axis) forms **an attribute**
- Each axis has either
  - an exact schema (e.g., numbers), or
  - a subjective schema (e.g., labels, tags)
- A common task: select a subset, search the subset successively
- Leads to filter and facet systems

# NAVIGATION PATTERNS

# Design goals

- Minimum **interaction cost**
- **Prioritization**
  - Frequent actions first
  - Desirable (by other stakeholders) actions first
- **Recognizability** and **discoverability**
  - Recognizing navigation elements as such
  - Predicting navigation actions
  - Trust

# Interaction cost

- **Cognitive and memory** load
  - Understanding page content
  - Deciding which actions are relevant
  - Memorizing information for subsequent use
- **Motor and sensory** load
  - Reading
  - Scrolling
  - Writing
  - Clicking and touching (with the necessary precision)
  - Moving attention
  - Waiting for content to appear

# Navigation in a hierarchy

- Each hierarchy level has a **distinct navigation**
  - Top level: global navigation
  - Level 2 (possibly, also level 3): local navigation, sometimes with sblings (pages on the same level)
  - Lower levels: links, breadcrumbs navigation
- **Recognizability**
  - Global and local navigation must be recognized as such
- **Discoverability**
  - Navigation tools must be visible → how to attract attention
  - Correct use of contrast

# Horizontal menus

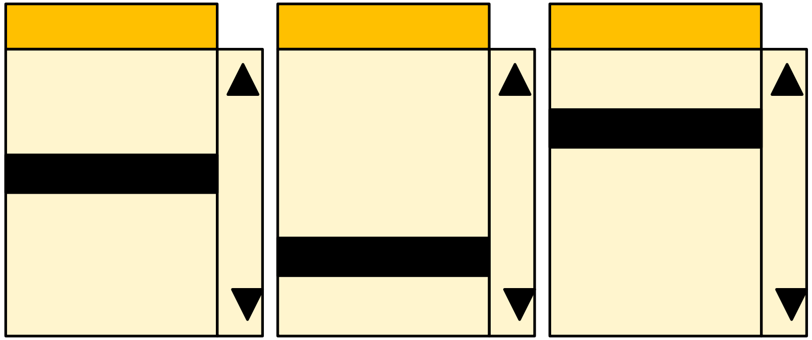
- Sometimes called Navigation Tabs
  - Take less space
  - Offer less space – do not deform information architecture to have less items in the top-level menu
  - 2-9 items, short names, static (not context-dependent)
- A variant: Module Tabs
  - Leads to similar targets
  - Does not refresh the page in the web context

# Vertical menus

- More visible items
- More chances for extension
- More effective when reading and scanning (see the Pattern Lecture)
- Well-known from applications
- Better transition to mobile
- Takes more space (the longer the page, the worse)

# Filters and facets

- Filters
  - Setting one or a few attributes
  - **Excluding** irrelevant objects
- Facets
  - Setting enough attributes to **identify** the target



- Example: choose a LED by: color, diameter, luminance, radiation angle, manufacturer
- **Enough** for a shop assistant to offer a product
- That is, the attributes form a **conceptual model of a LED**

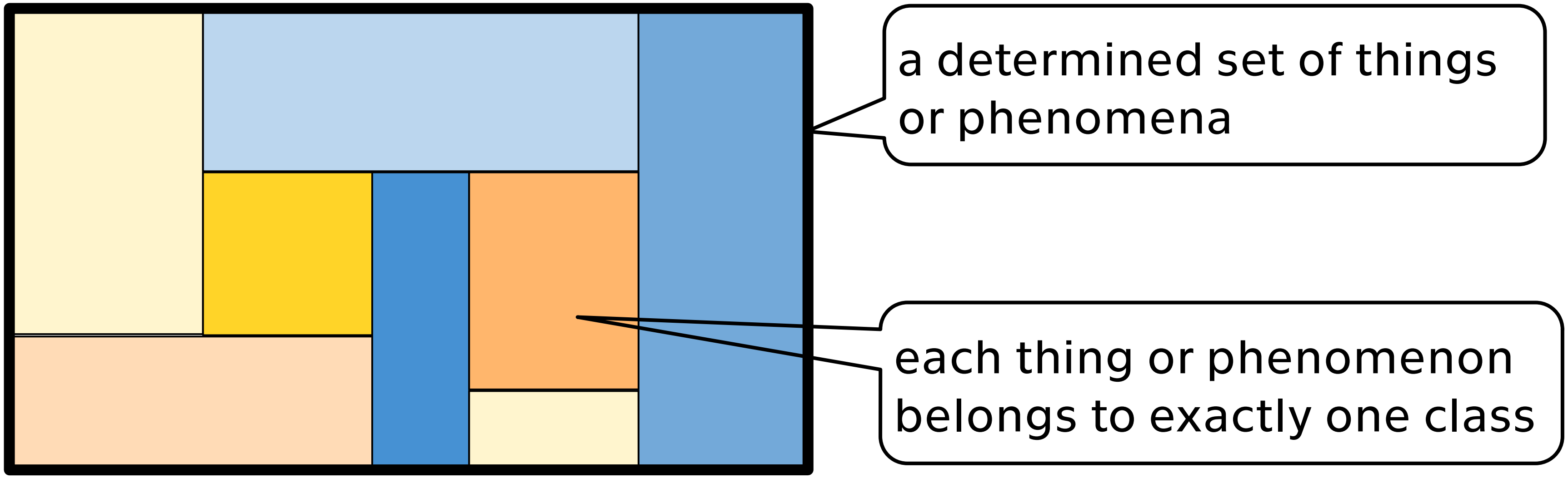
# General hypertext

- "Let me create a garden for your morning walk"
- More important as in other schemata: the notions of **place** and **path**
  - Many paths leading to the same place
  - Danger of getting lost
- A hyperlink as a **general association**
  - HTML: the simplest one-way reference
  - Fat/multi-tailed links: multiple targets, simultaneously (tabs)
  - Typed links: internal-external
- User links
  - Annotations
  - Guided tours

# CLASSIFICATION SYSTEMS

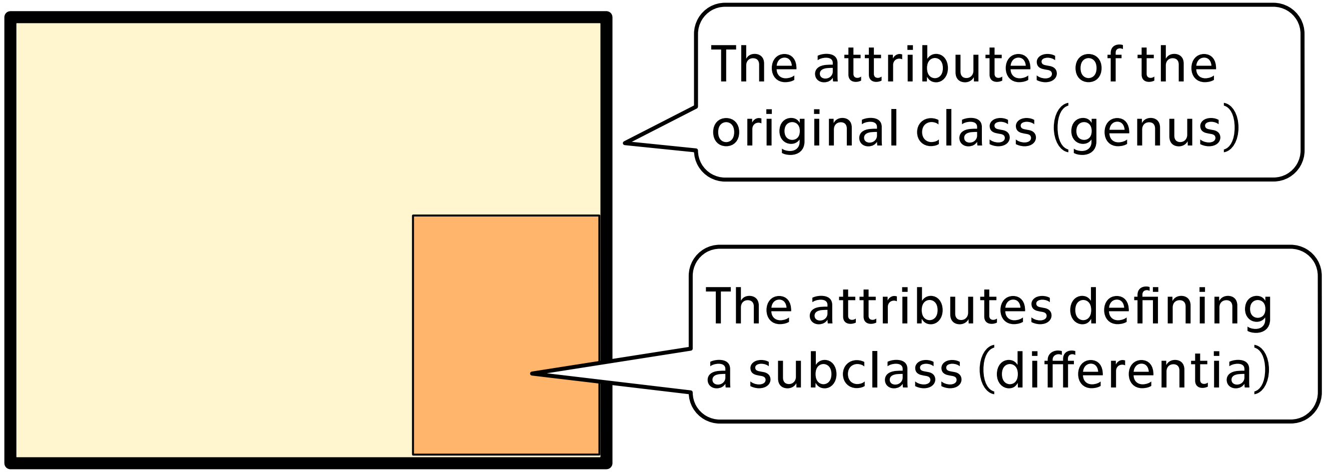
# A classification system

- An ideal classification system can possibly be the foundation of a simple hierarchy



# Classification

- We need a procedure that assigns a class to every classified entity
- We use attributes
- A common procedure: Aristotelian definitions by attributes (Genus proximum et differentia specifica)



# A teacher's example: what is a drum?

- **What the teacher (probably) wanted to hear:**
  - Genus = musical instrument
  - Differentia = played by hitting (percussions)
- **What the class invented:**
  - Genus = percussions
  - Differentia = ?? having a membrane, a resonator?
- **In theory:**
  - Membranophones in the Sachs–Hornbostel classification
  - „… divided instruments into four broad categories according to the nature of the sound-producing material: an air column; string; membrane; and body of the instrument. "

# Cognitive problems with drums

- Sachs-Hornbostel: a classification system, a simple hierarchy – each instruments **in exactly one category**
  - Chordophones (strings)
  - Aerophones (air)
  - Idiophones (instrument body): including triangles, woodblocks, some African drums
  - Membranophones (membrane): including common drums

# Cognitive problems with drums

- Problems **solved**:
  - Good differentia
  - Stability, unambiguity
- Problem **not solved**: does not correspond to **common mental models**
  - The notion of percussions is neither included nor can be defined using this classification

# Practical classification

- A classification system follows from the outcome of **context analysis** (in the example: how the musicians name and classify their instruments)
- Context analysis must be based on multiple **mental models**
- Each of them is **ambiguous** and **vague** (in the example: the contradictions in participants' definitions)
- Leads to a **polyhierarchy**
- In general, leads to **hybrid hierarchies** (as a compromise)
- In some cases (professional artifacts), mental models include or are close to the theoretical classification: simple hierarchy, unambiguous names

# Practical polyhierarchies

- One term in more categories
- In practice: **constrained** polyhierarchy
  - Has a feasible number of categories at each level
  - Does not include every mental model
- Problems with some design patterns
  - Breadcrumb navigation can show only one path
  - By consent, the path is independent of the path of user's arrival
  - Hence, a canonical path displayed

# More on labels

- Labels can be **textual** (names) or **iconic** (pictorial)
- Labels are used
  - in navigation systems
  - for indexing (books)
  - as links in text
  - as titles
- In indirect manipulation, their actions have to be predictable:
  - consistent: apparently relevant to a **labeling system**
  - e.g., having a good **parallel structure**
  - if there is context-dependent semantics:
    does the user see the context?

# Designing and testing categories

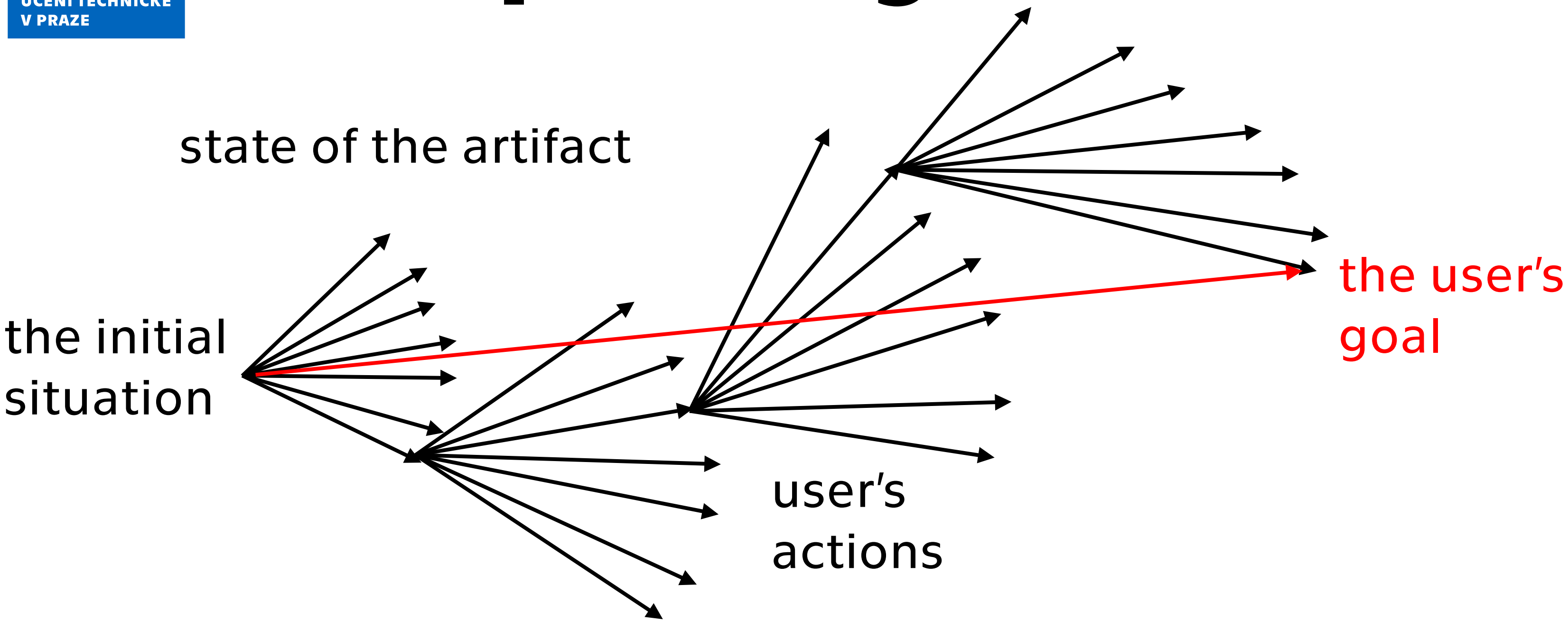
- Card sorting
  - Small cards with leaf names
  - Blank cards for higher-level categories
  - Each user builds their own tree, the result is recorded
  - Danger: the “Others” category
  - Danger: a large number of totally different categories
- Closed card sorting
  - Ditto, with given categories
  - User hesitating, attempts at polyhierarchies: recorded

# Designing and testing categories

- Tree testing
- Given
  - The complete tree – revealed level by level
  - A user's goal – a category, a leaf
- Testers try to reach the category
  - backtracking recorded,
  - debriefing

# USER SUPPORT

# Path planning




- Taking step in the real app: gathering info in each step
- Ready-made paths for foreseen goals
- Memorized paths
- Ad hoc planning

# What may fail

- **The entire path plan**
  - set out in an estimated direction, gather information as it becomes available (observability, confidence)
  - no plan at all – support needed
- **A sub-plan for a step**
  - the existence of such a step
- **The realization of a step**
  - „which line leads to the marionette's left leg" – translating intention (semantics) to actions (syntax)
  - „what can be manipulated"

# Categories of support

- **User's goals** support
  - how (the known) user's goals can be realized
- **State-dependent** support
  - (sub)goals that can be realized in a given state
- **Syntax** support
  - feasible actions with user interface elements
  - command syntax
  - direct manipulation

# Supporting user's goals

- Explains how to satisfy **the foreseen goals**
- Early rise of the learning curve
- Structured **by goals**
- Often use cases employed in creating the app
- FAQ: feedback goal support
- **Names for goals?**
- Mental model built by composition and generalization of concrete paths

# State-bound (context) support

- Help or explanation bound to an element characteristic for that state
- Typically, both syntax and semantics
- Which part of app state is meaningful for the support?
- What if the incorrect state is the problem?

# Support at the syntax level

- Easy to create, therefore existing
- “Cheat sheets” with syntax since the 60's
- “What is this”, balloon help

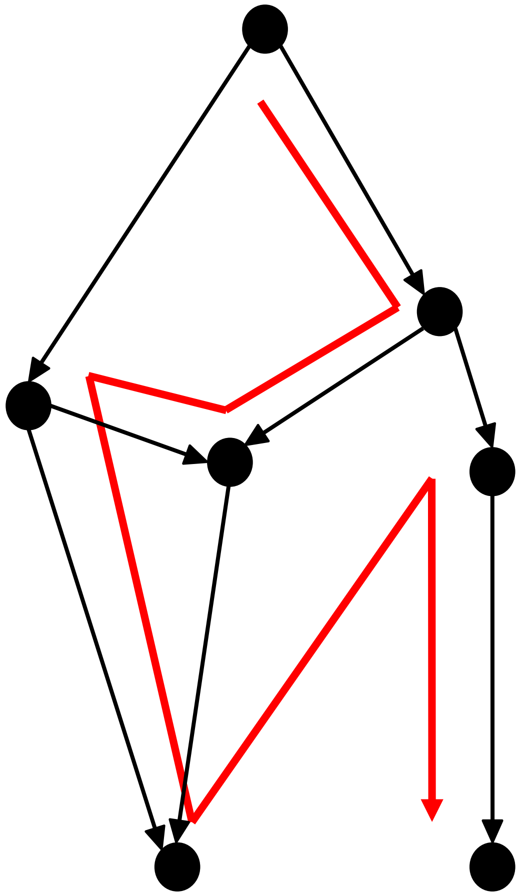
# Reference material

- A description of all possible actions, their syntax and semantics
- **„A contract“** from the app to the user
- Goodwill, integrity, ability => **trust**
- Integrity:
  - the material must correspond to the artifact
  - a feature is either documented or does not exist
  - all consequences of taking an action are documented
- Ability:
  - the artifact performs at the documented level

# Reading patterns (not only in support)

- Usual ways (in a domain) **to use the text**
- Information search in research publications:
  - Abstract (Is it about the thing I need? no → stop)
  - Conclusions (Did they discover something useful for me? no → stop)
  - Text (How did they come to that conclusion?)
- **Continuous reading:** in an author-defined sequence
- **Alternate sequences:** one textbook for multiple courses
- **Discontinuous reading:** landing in the middle of the text
  - by contents (a chapter)
  - by index (a term, a notion)

# Document structure



- The conceptual model of a document:
  - a **general directed graph**
- Continuous text: **linear sequence**
- **How to map a graph to a linear sequence?**
- Escaping the linearity of text: footnotes, remarks, frames
- Different treatment of the same material – different **paths** through the conceptual model
- no edge: bridged by a phrase, e.g. "further let us discuss..."

# Technical manual
## continuous reading

- At the beginning: assumed user's knowledge (domain tasks, the platform)
- Along the path: accumulating to the mental model
- From the well-known to the unknown (**spiral**)
- At the end: fulfilling **the goal of the manual**

# Technical manual
## discontinuous reading

- At any place: assume user's knowledge as with continuous reading
- Explicit references to closely related information
- A navigation system to provide other links required
  - index (paper)
  - in-text references (paper), hyperlinks
  - table of contents (paper), vertical menu

# Glossary

- Motivation: some well-prepared material from conceptual model, domain analysis etc. available
- Agreeing on the exact meaning of a term can save mental model mismatch
- Discontinuous reading
  - A navigation tool for terms (e.g. index) not referenced explicitly
  - A necessary component of reference material
- Continuous reading
  - Unforeseen or diverse user's goals
  - In-depth learning expected (frequent, professional use)

# People

- **Informal help**
  - same or different place
  - same or different time
- **Formal contact**
  - internal
  - external to an organization
- **Human factors**
  - a dialogue is iterative – can bridge differences in mental models
  - problem-solving intelligence
  - social factors: the ability to make contact, the fear from possible loss of face

# Training

- Fixed or little-varied topic sequence – a limited number of different conceptual model traversals
- Spiral path again
- Contact proximity:
  - Classroom
  - Correspondence
  - E-learning
  - Video training
  - Wizards

Diminishing role of human factors

# Summary

- Content organization
  - structure – linear, multidimensional, hierarchical
  - schema – exact, subjective
- Navigation: design goals, navigation in a hierarchy, in a multidimensional space
- Classification systems, Aristotelian definition, practical classification and its design
- User support
  - by category: goal support, state-bound support, syntax support
  - reference manual
  - reading patterns
  - conceptual model of a text

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# ERGONOMY AND ACCESSIBILITY

FIT ČVUT, KATEDRA ČÍSLICOVÉHO NÁVRHU

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2024

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# ERGONOMY AND ACCESSIBILITY

- ERGONOMY AND HCI, PHYSICAL ERGONOMY
- PERCEPTIVE LOAD
- MOTOR LOAD

# Ergonomy: about work and work environment

- **Organization ergonomy:** how the organization of work suits social relations and communities
- **Cognitive ergonomy:** how the arrangement of work suits human cognition → comprises understanding, skills, decision, HCI…
- **Physical ergonomy:** how the work process and tools suit the possibilities and abilities of human body
  - comfort
  - performance
  - load, fatigue

# Standards

- ISO 9241-420:2011 – Ergonomics of human-system interaction – Part 420: Selection of physical input devices
- ISO 9241-400:2007 – Ergonomics of human-system interaction – Part 400: Principles and requirements for physical input devices

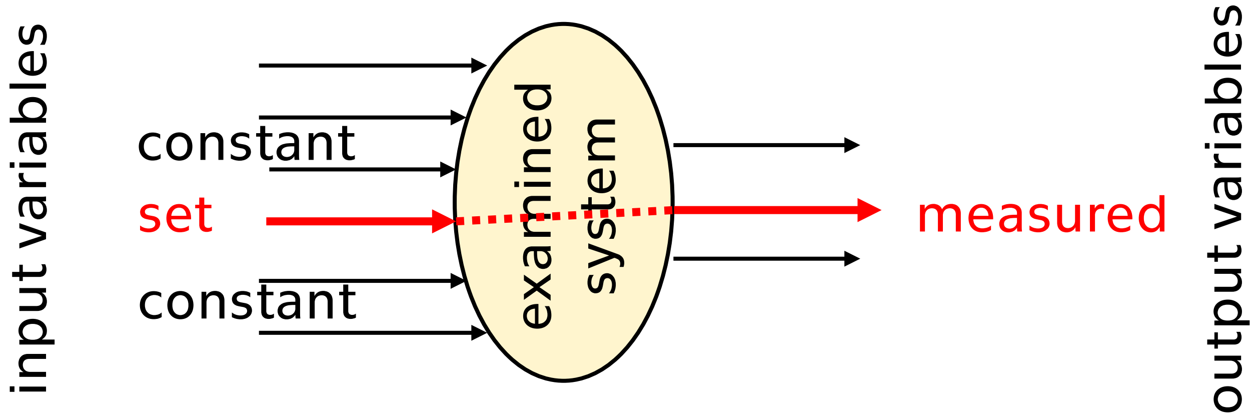
# How big shall that shovel be?

wikipedia

Frederick Taylor:
Optimum load to achieve best performance for an average stoker is 9,8 kg. Use shovels of size corresponding to the material.

# Quantitative experiment

- **Independent** (set) variable: shovel size
- **Dependent** (measured) variable: weight of material transported in a unit of time
- **Constant** (kept) variables: fatigue, skill, muscular strength, handle shape, air temperature …



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# HUMAN BODY: MOVEMENT

# Motor system

- The source of force: (skeleton) muscles – convert chemical energy to mechanical.
- Muscles, bones, joints: mechanical system - static properties and dynamic properties → biomechanics.
- Force and acceleration – distinct parameters: sports that require
  - strength,
  - speed,
  - or perseverance

# Motor load

- **Dynamic load** – short term, variable.
  - nutrition concentration declines, metabolites concentration increases
  - force decreases with repetition
  - fatigue
- Static load – long term, constant.
  - cca 28% peak force

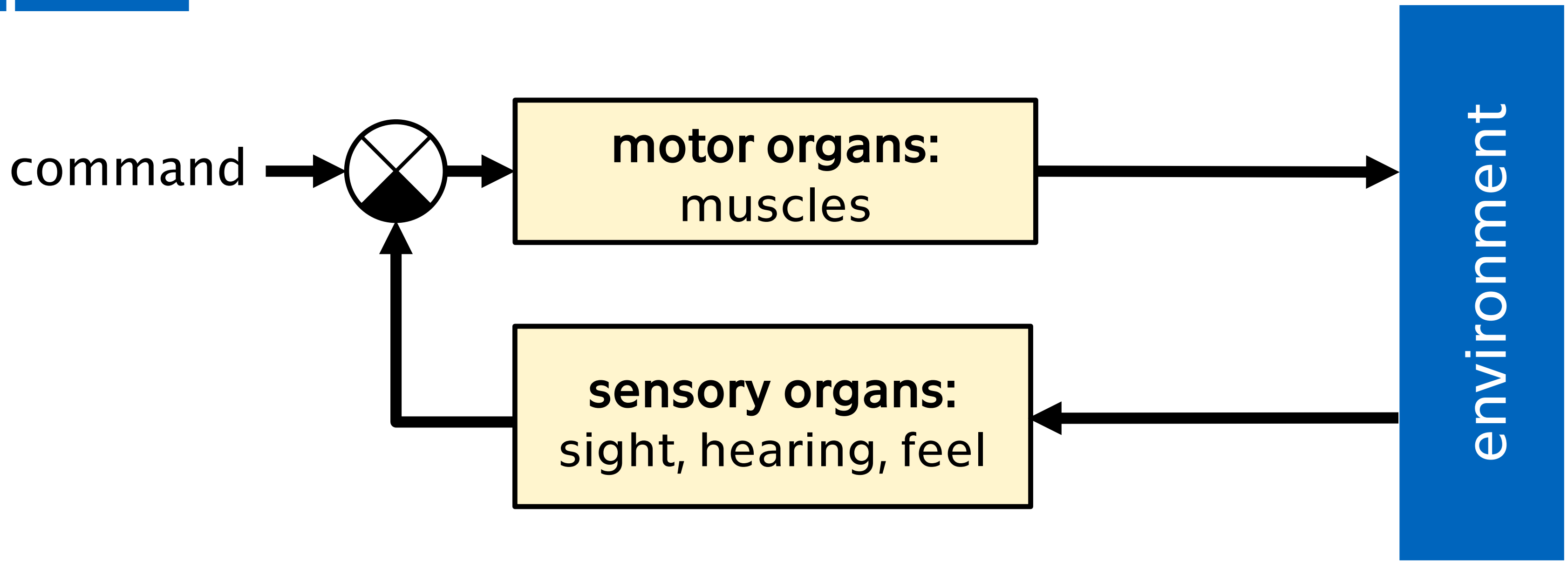
# Bones, joints and muscles

- Movement in a joint:
  - one or more degrees of freedom
  - two directions in each degree of freedom
  - → muscles in pairs
- **„Large“** movement: one muscle works, the other one is released
- **„Small and accurate“** movement: the muscles act **against each other**
  - → movements and forces smaller than normal are disadvantageous
- → each muscle shall perform an adequate work
  („mid of the characteristics“)

# Muscles in counterforce

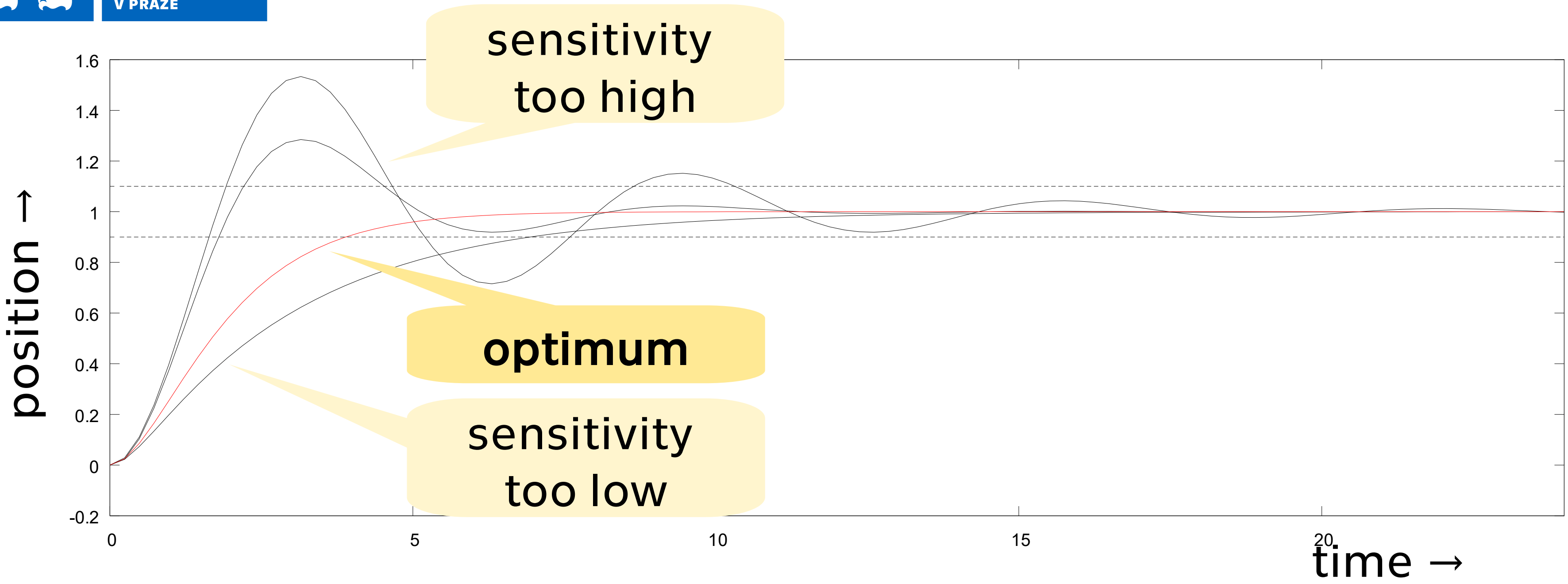
- **Awaiting** (some danger…)
  - subconscious preparation for a swift physical action
- **Accurate** movement
- **Stable position**
  - Keeping body posture – loaded by body part weight
  - Holding an object – additionally loaded by its weight
- **Consequences**
  - Fatigue
  - Frequent overloading of small muscles – pain, spasm

# Feedback control



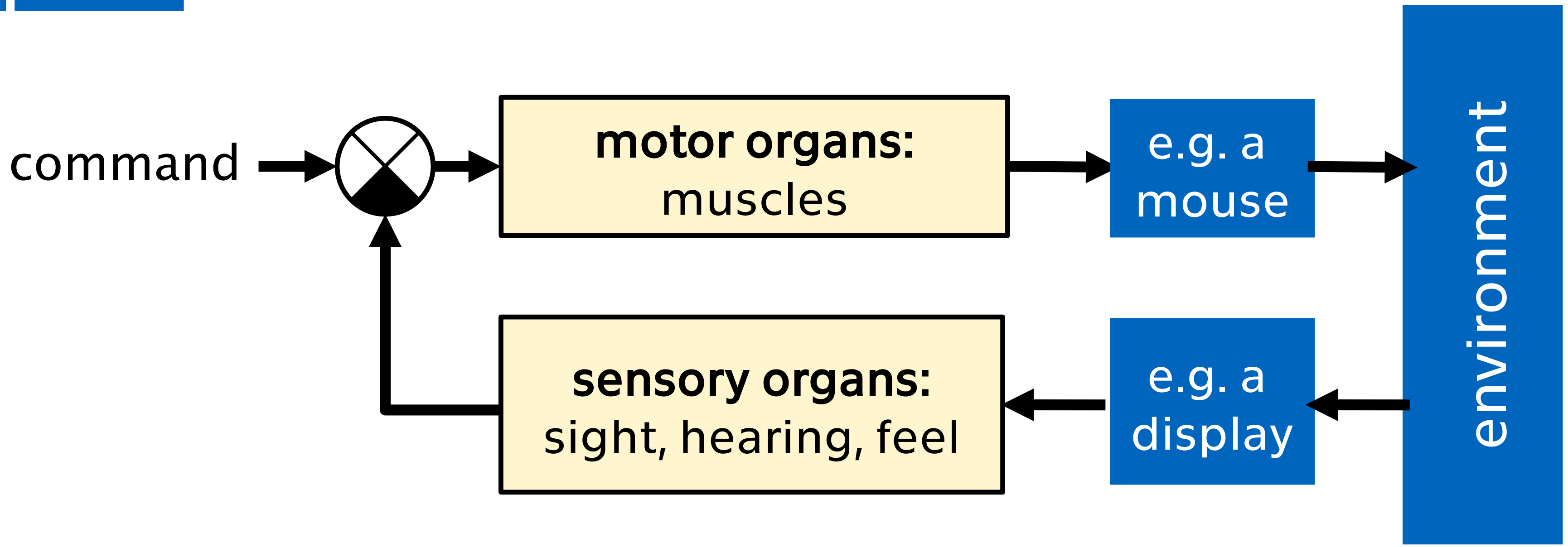

- The desired behavior of the feedback loop:
  - motion – speed needed
  - stable state – accuracy needed
  - adaptation – by exercise, training

# Feedback loop - response



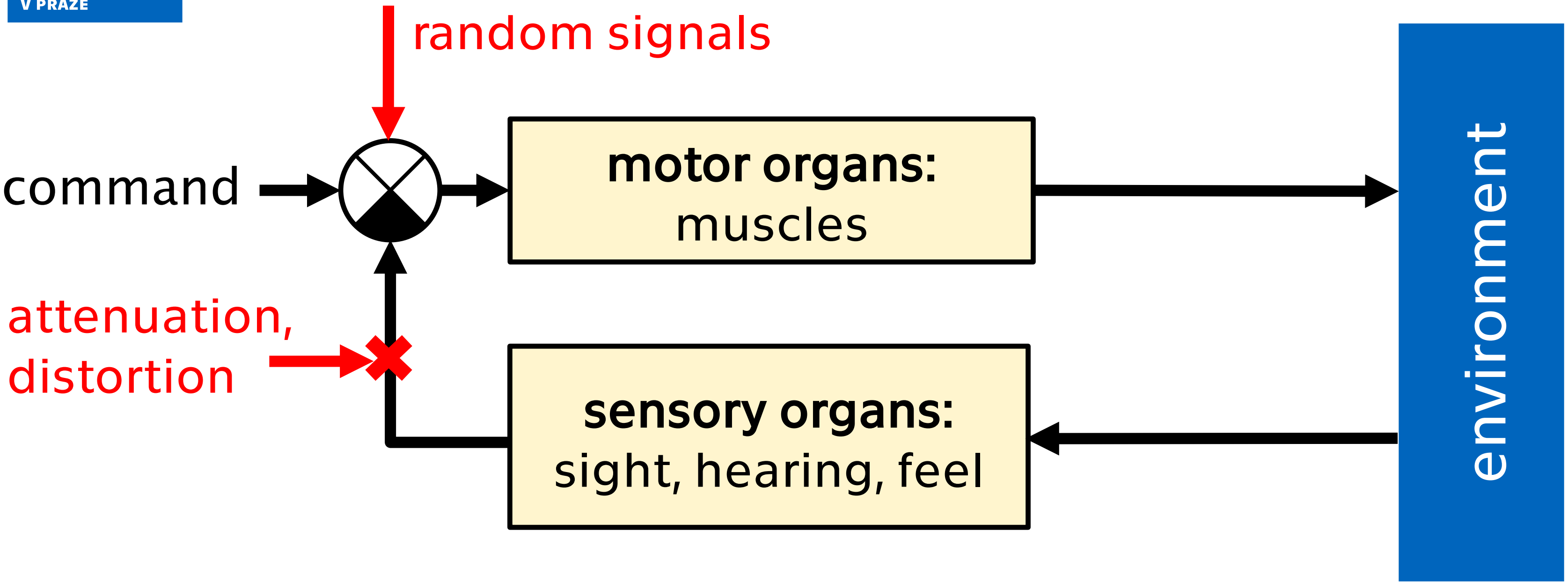

- Optimum control: a critically damped system
- Optimum control through adaptation
- Badly adapted loop: oscillatory response

# Indirect feedback




- Adaptation:
  - to actuator parameters (mouse ratio)
  - to response (level, speed, kind)

# Motor impairment




- The effects:
  - random shaking decreasing with effort
  - random shaking **increasing** with effort
  - inaccuracy

# Serious motor impairment

- Motor organs missing or uncontrollable (spine injury etc.)
  - paraplegy – legs only
  - quadruplegy – legs and hands

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# HUMAN BODY: SENSES

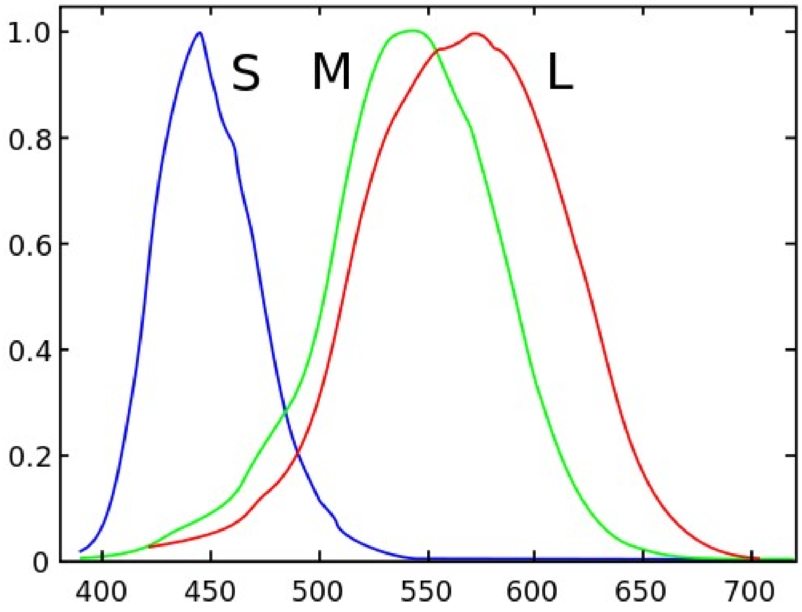
# Sensory channels

- **Important channels**
  - Sight: most of the cases
  - Hearing
- **Logarithmic in nature**
  - to **add** loudness by a constant step means to **multiply** the power by a constant factor
  - logarithmic measures: dB ($10\log_{10}$), f-stops ($\log_2$)
- **Adaptability**
  - on top of the log response, takes time
- **Wide dynamic range**
  - hearing: $10^{10}$ (100dB), sight: $10^9$ (90dB)
  - **not** simultaneously – involves adaptation

# Sensoric adaptation

- At the organ level
  - eye – muscles that control the pupil in the iris
  - eye – muscles controlling the shape of the main chamber
  - ear – no organ-level adaptation
- At the processing level
  - eye – optical faults (geometry, color) correction
  - ear – shifting the analyzed sound range → (mis)used in lossy compression

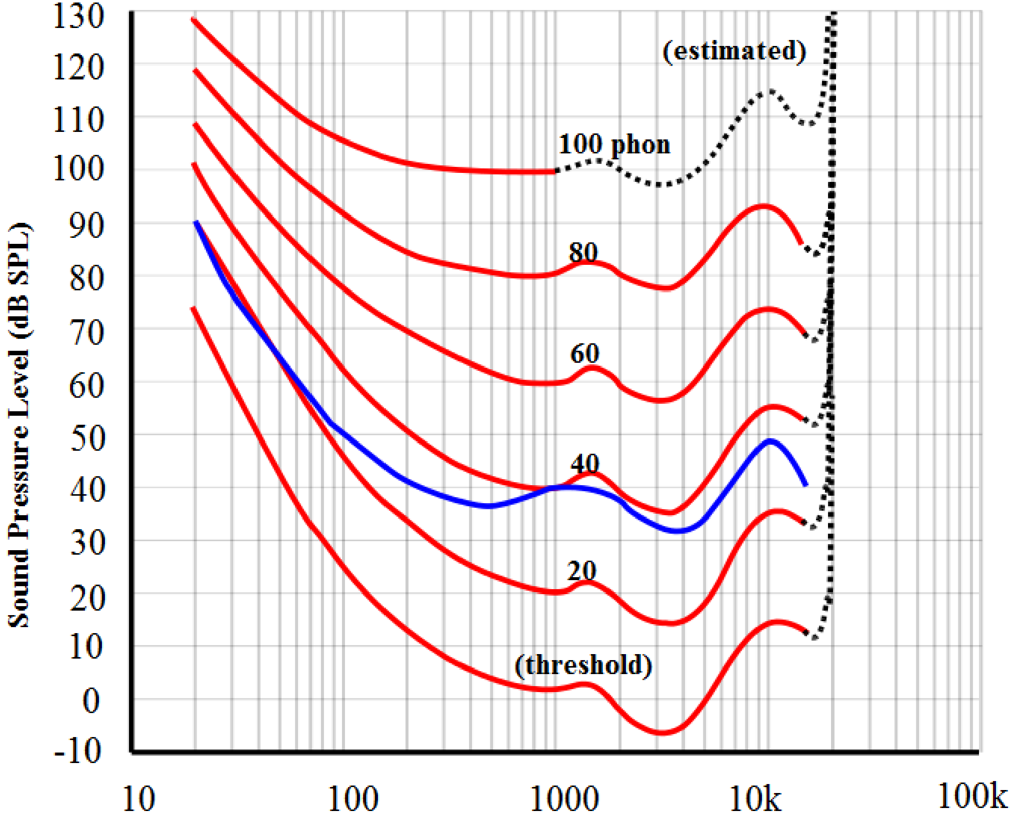
# Visual impairment




- Color blindness
  - rarely complete
  - one type of cones not working
  - one type of cones working differently – most frequent: green cones have a shifted response, influences red-green discrimination, cca5% of European population
- Blur
  - optical defects in the eye
- Blindness

# Hearing

The curves show how high sound pressure level (an objective measurement) is perceived as equally loud (a subjective response) depending on frequency (tone pitch)




Equal-loudness contours (red) (from ISO 226:2003 revision)
Original ISO standard shown (blue) for 40-phons

- **Excessive load:**
  - → adaptation
  - → damage
- **Sensitivity loss**
- **Adaptation:**
  - temporary loss of sensitivity (short-term, long-term – even days)
- **Damage:**
  - permanent loss, frequency-dependent

# Hearing impairment

- Impairment
  - loudness contours shift
  - depends on frequency
- Causes
  - physiological changes in older persons - high frequencies
  - permanent damage (long exposition to high sound pressure levels)
- Deafness
  - developmental, gained
  - one or both ears

# Communication defects

- Dyslexy – reading, learning
- Dysgraphy – writing
- Dysortography – grammar and spelling
- Dyscalculy – arithmetics
- Dysphasy – speaking

# Cognitive defects

- Interpretation, memory, concentration, planning
  - Serious
    - Alzheimer
    - Down syndrome
    - Mental retardation
  - Common
    - working or long-term memory deficiencies
    - planning
    - ADHD – Attention Deficiency with Hyperkinetic Defect

# LOAD LIMITING

# Load and fatigue in IT

- Body position
  - static motor load
- Hands position and movements
  - static and dynamic motor load
- Visual fatigue
- Hearing fatigue

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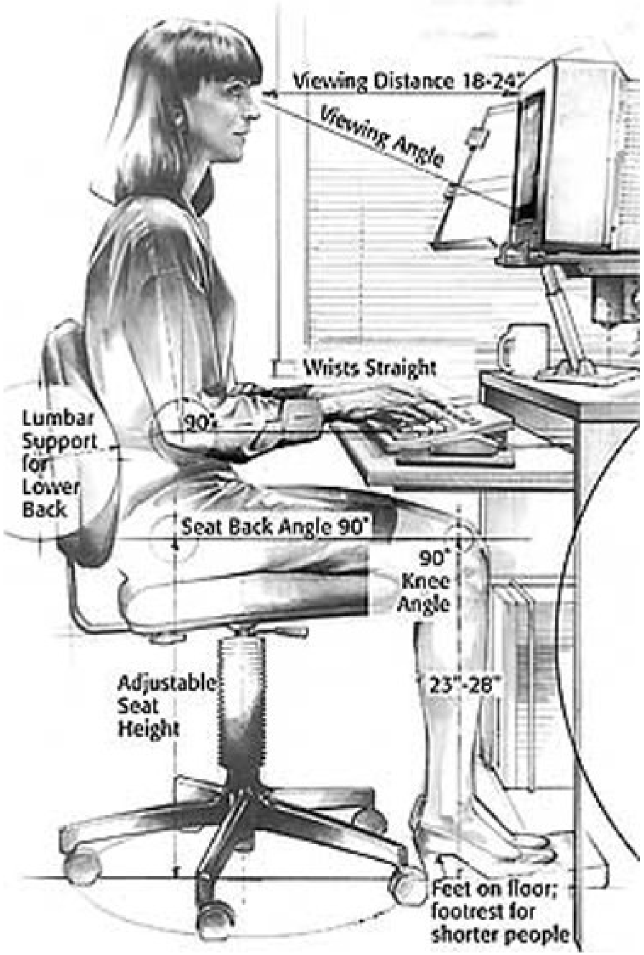
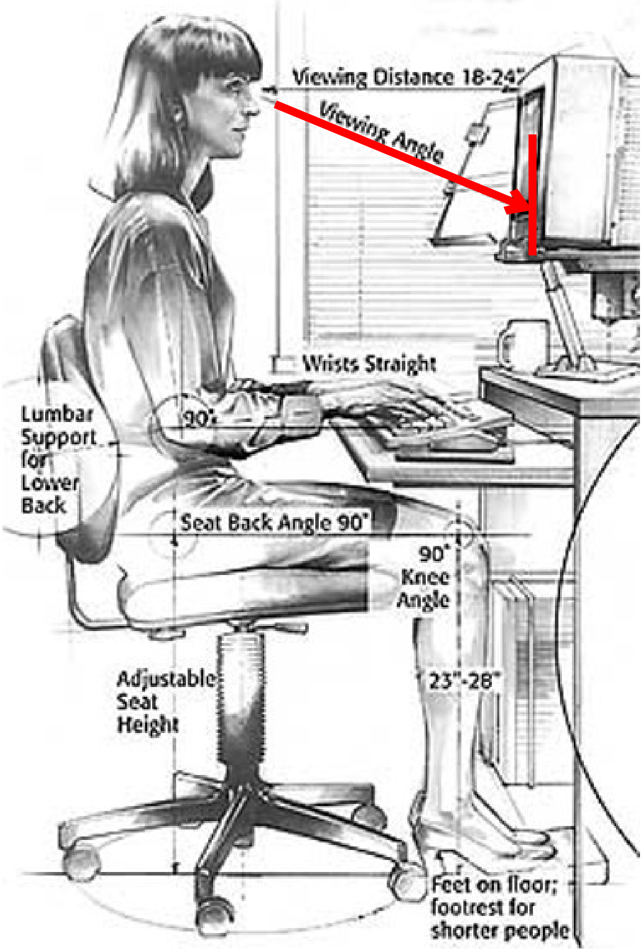
# Static load limitation



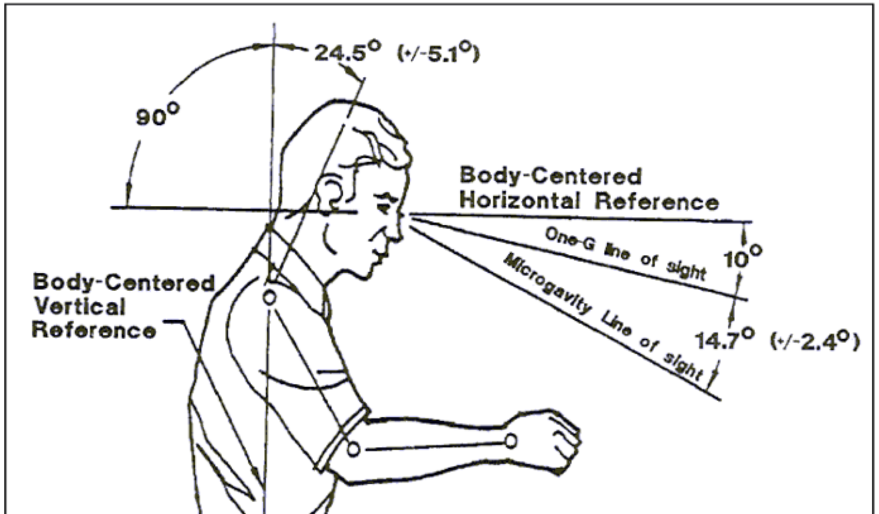

- Muscles in the back
- Muscles in the neck
- Leg muscles
- + perceptive load

- Pain from overloaded muscles and small injuries amplified by psychosomatic mechanisms → **Repetitive Strain Injury** - without a clean clinical image

# Viewing angle

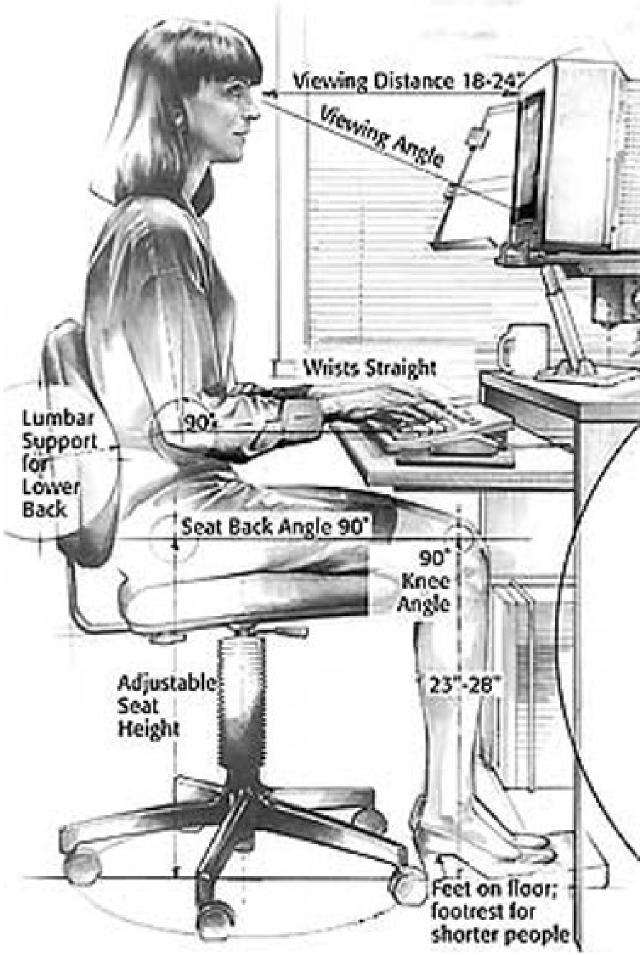



- Reading distance:
  - print: 300-400 mm
  - display: 500-1000 mm
- Angle to reading surface:
  - 90°±15°



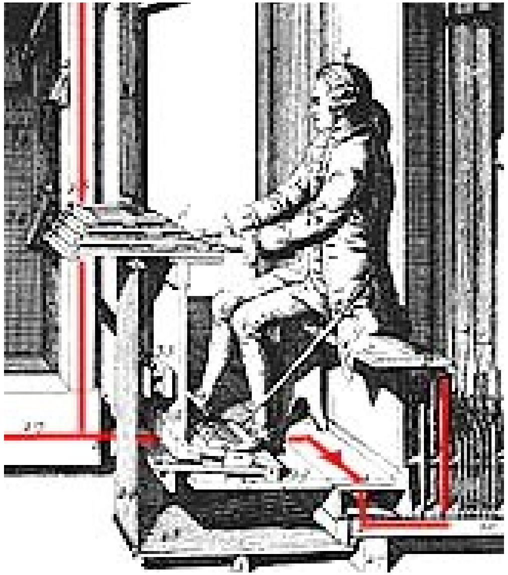

[NASA]

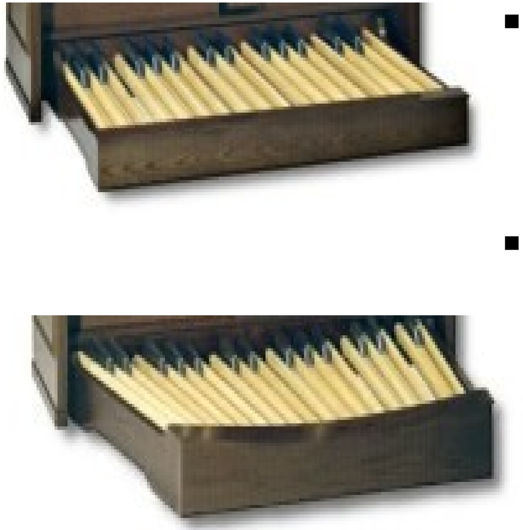
# Manipulation posture




- Optimum surface angle
  - 0°-30°
  - fingers from above
- Position: arms vertical (no static load)
- Because of the head position, blind typing required. Feedback
  - from motor memory
  - by haptic sense
- Wrist lifted – carpal syndrome

# Organ pedals and knee controls of the cursor

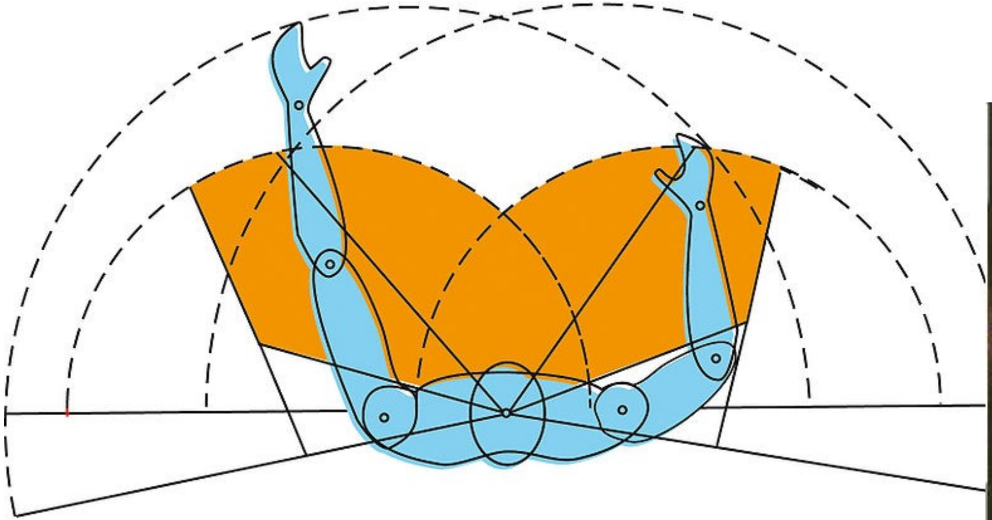




- Keys and key force enlarged proportionally to the muscles.
- The shape of the keyboard adapted to rotation in the hip joint

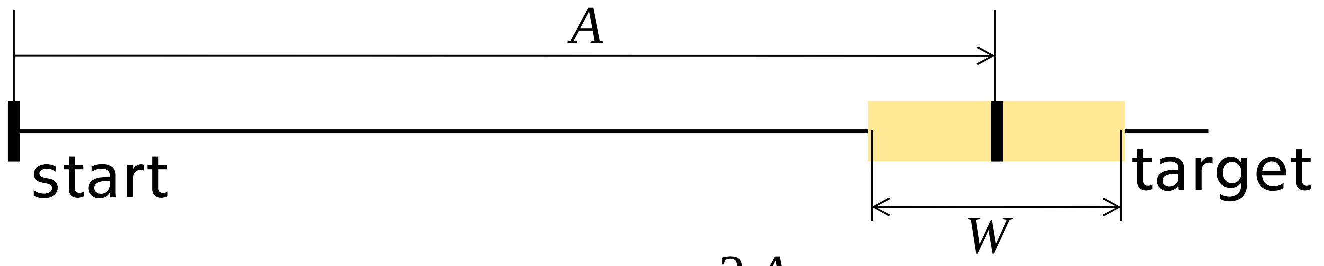
Knee controls: tests in the eighties – on a par with other lever controls (i.e., worse than the mouse).

# Reachability



Operational area
with the body stationed

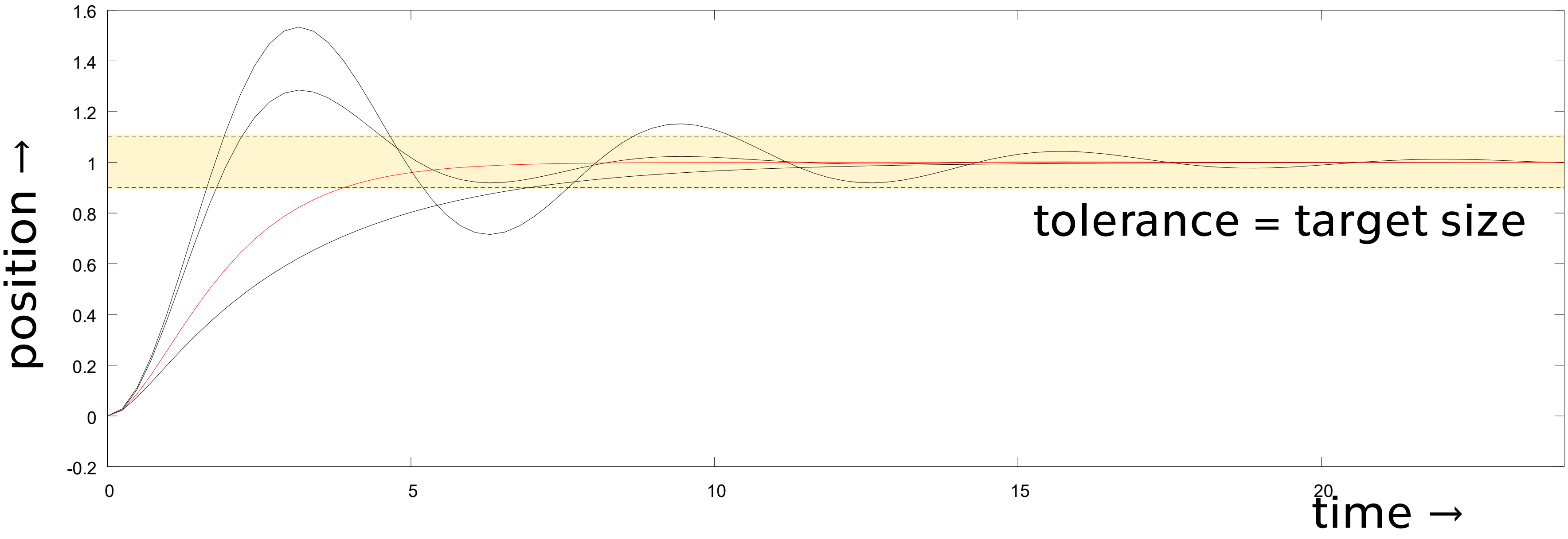
# Speed and accuracy: Fitt's law




time to target $T = a + b \log_2 \frac{2A}{W}$

- The speed depends only on the **ratio** of distance to the target size
- Holds for 2D movement (2D)
- Holds for movement **timing**
- Similar formulas for more complicated movements

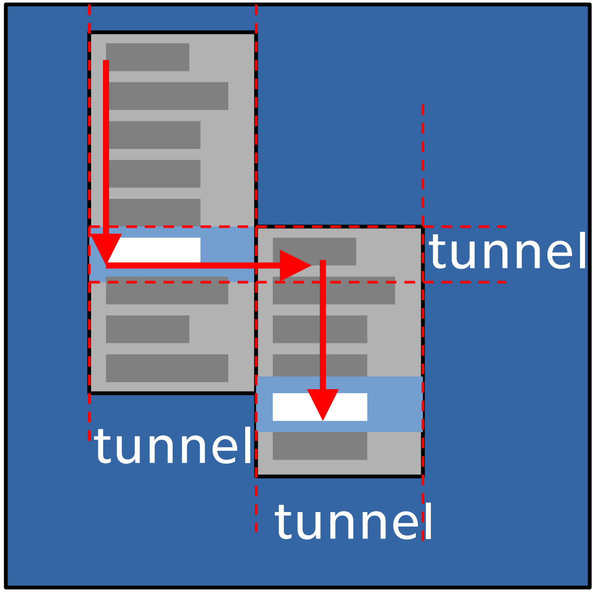
# Fitt's law and control theory

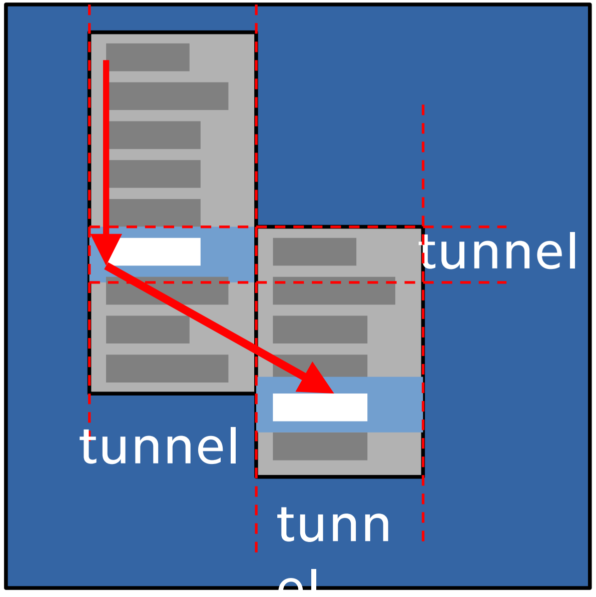



- Settling time depends on tolerance
- Optimum control: a critically damped system
- Optimum control through **adaptation**

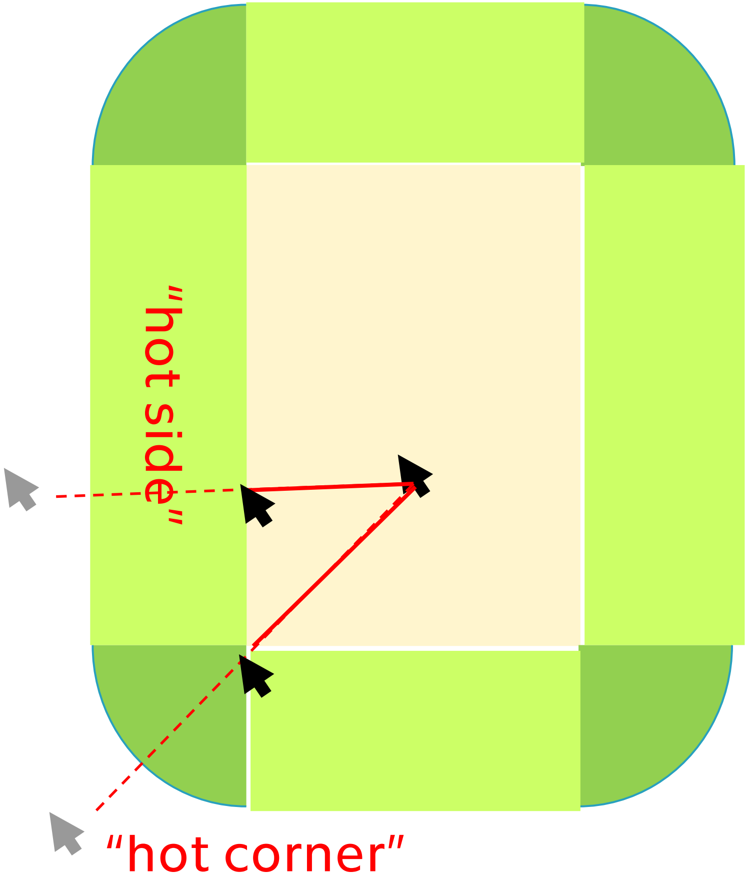
# A consequence of the Fitt's law
## Accot-Zhai Steering Law

- Holds even during movement though a log, limited „tunnel"
- Avoid elements needing increased accuracy (hierarchical menus, sliders, ...)
- Provide alternate controls where possible (e.g., arrow keys)



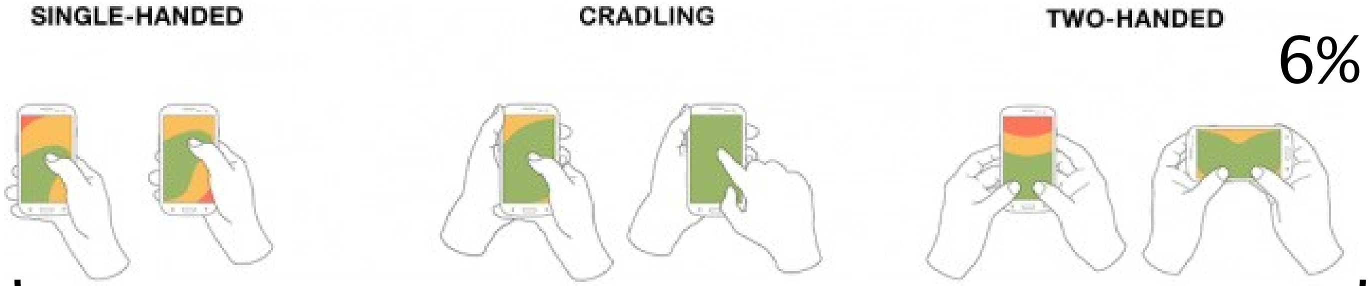
# The consequences of Fitt's law




- Targets and gaps between them as large as possible
- Targets that are hit in sequence close together
- Cursor stops at the display border:
  - borders are "large"
  - window frame cancels the effect

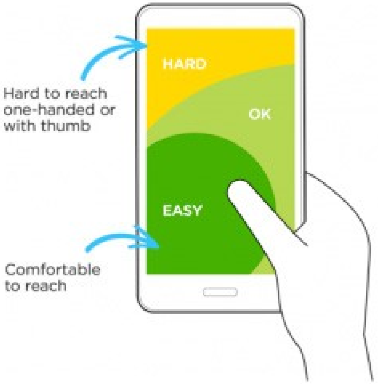
# Reachability in mobile devices

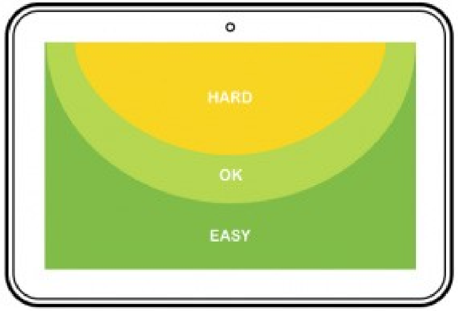
49%



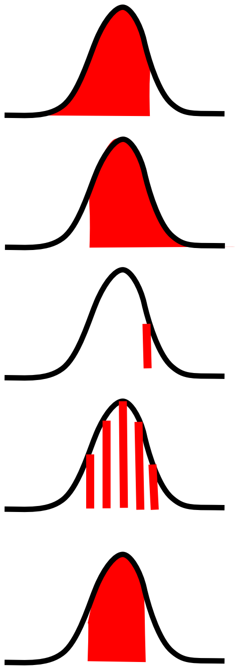

6%

Thumb use: 75%



# Designing for . . .



- max size: door, tramways...
- min size: shelf height, tool weight...
- adaptability: cockpits, driver's seats...
- selectable size: shoes, clothing...
- average size: if everything else fails

# Eye load, eye fatigue

- Blurred image → constant re-focusing
- Red and blue image → constant re-focusing
  (due to color faults, the eye's focus differs in red and blue light)
- Low contrast → difficult processing
- Too high a contrast → constant pupil adaptation

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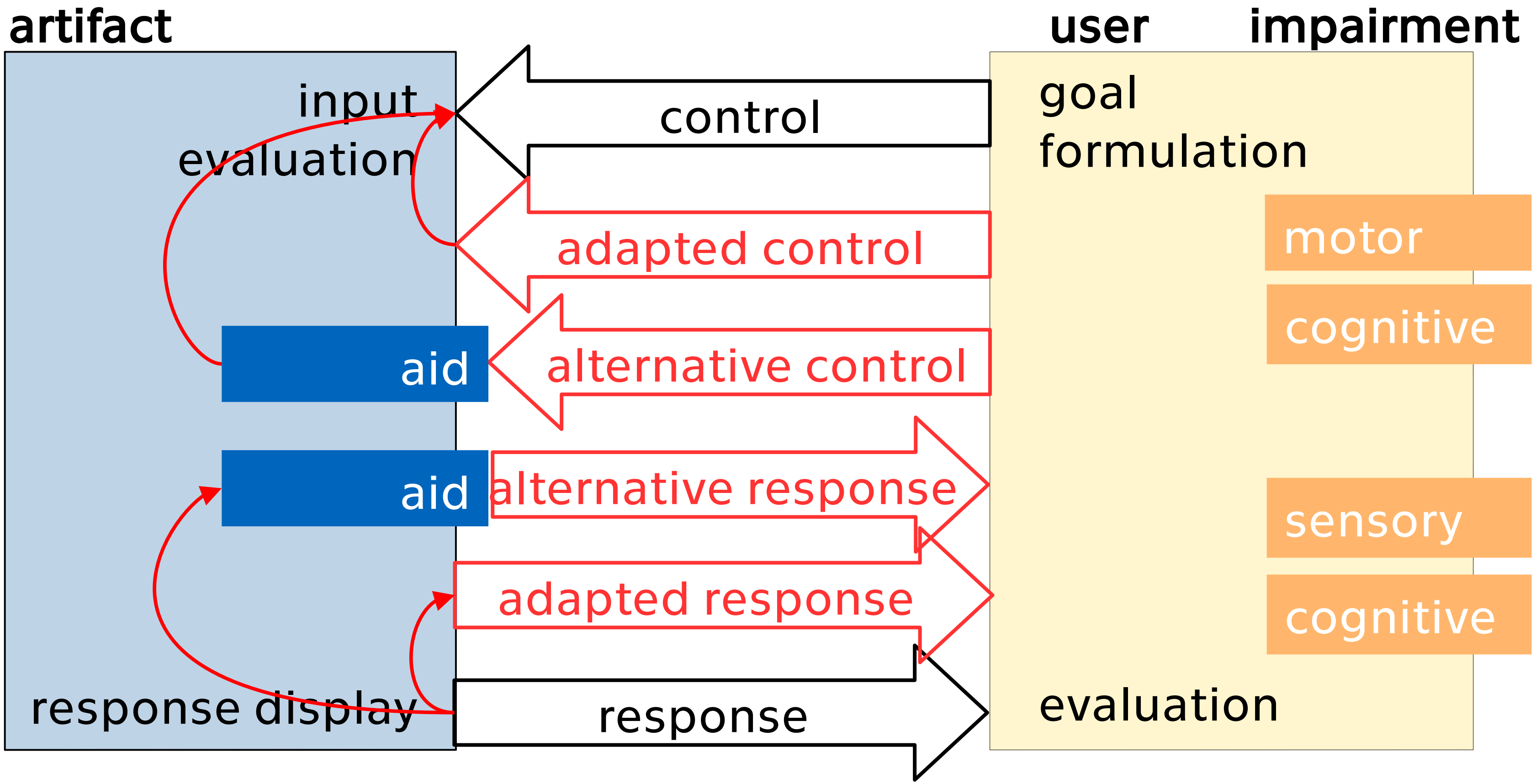
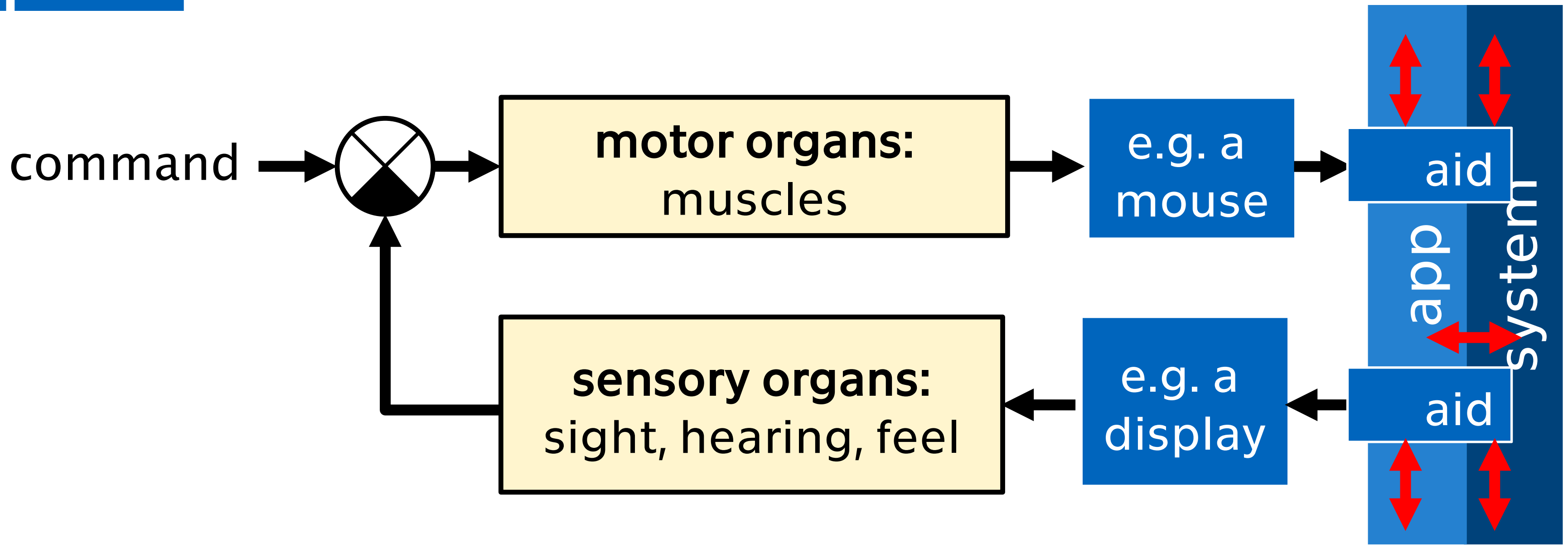
# SPECIAL INTERFACES

# Alternative ways of interaction



# Implementation




- The application must enable the cooperation of all components → rules

# Adapted response: sight

- **Size enlargement**
  - Application level
  - System level
  - Must not be blocked
  - Must be accessible anywhere
- **Contrast**
  - High-contrast themes (icons, controls)
  - Contrast control in standard widgets
- **Color** not the only way to communicate meaning
  - color vision impairment
  - cultural differences

# Adapted response: sight

- **Blinking** only when necessary and under control
  - invasive elements, diverts attention
  - long exposure can provoke seizures
  - controllable period

# Adapted response: sound

- **Sound** cannot be the only way to communicate meaning – in parallel with other channels, e.g., display blink (MacOS)
  - shall respect auditory limitation
  - cannot convey much meaning
  - might disturb the environment
  - might be disturbed by the environment

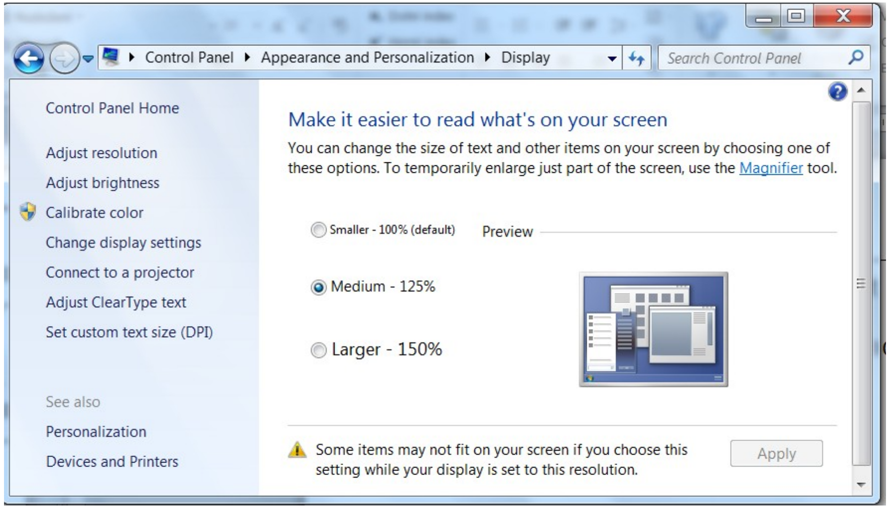
# Adapted controls

- **Precision** in control:
  - large targets, inactive surrounding area
  - positioning grid
- **Timing**
  - all times derived from a single constant (“user speed”)
  - e.g., a double click vs. two single clicks
  - e.g., pressing a key combination vs. pressing two keys
- **Interaction** style – alternatives
  - mouse or keyboard
  - external control – external keyboard

# Aids

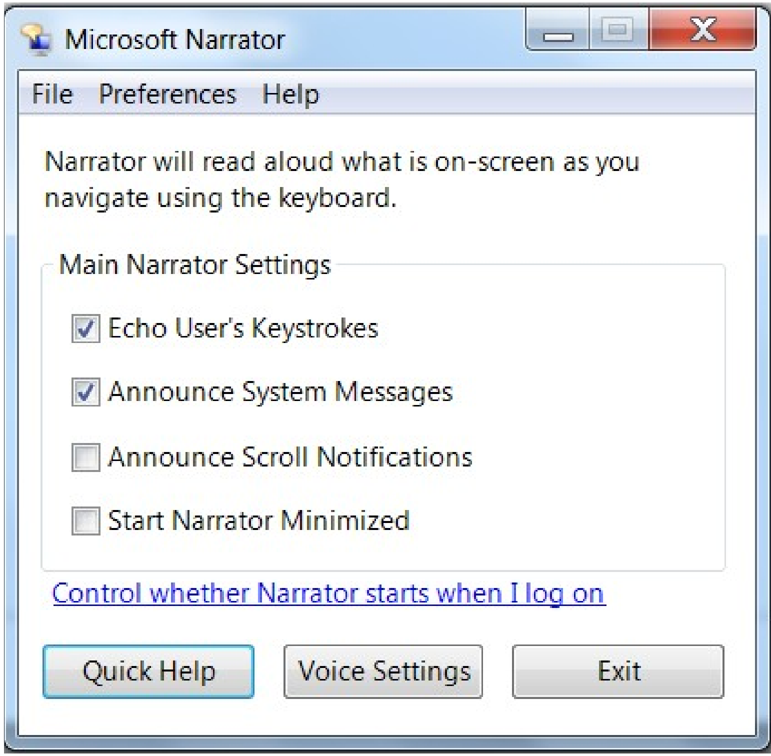
- **Magnifiers**
  - for blurred vision, etc.
- **Readers**
  - for heavily impaired vision, blindness
- **Voice control**
  - for all serious motor impairments
- **Screen keyboard**
  - for all serious motor impairments
- **Keyboard filters**
  - for control loop impairments

# Magnifiers




- **GUI scale factor** and variable font size
  - many browsers
  - graphic apps (also motor scale?)
- **Special apps** or platform **accessory**
  - magnifier window or full screen
  - control by mouse or keys
  - moved when focus moves
  - often integrated with the platform

# Screen readers




- Replace visual information
- **A problem:**
  - UI … 2D
  - voice output… 1D
  - Braille display… 1D
- Another problem:
  - Needs to say the **meaning,** not the **look** of the screen components
  - **Needs to know system components** in the app
  - A database of on-screen elements
  - Monitoring the app state

# Keyboard aids and adaptation

- Supporting **alternative input** – keyboard everywhere
  - focusing controls in sequence (e.g. the Tab key)
  - expect more difficult mental model building
- Keyboard **filters**
  - motor defect (shaking, coordination)
  - recognizes unwanted key presses
  - slow but correct typing
- **Screen keyboard**
  - replaces hands with other – possibly less fine – motor output
  - e.g. the headpointer – pointing by head movements

# Voice control

- Replaces **motor output**, mostly hands
- How to replace mouse pointing (direct → indirect identification)?
  - everything has a label
  - everything is identified by telling the label
  - if a screen reader is used, the labels can be visible for the reader only

# The rules

- Check the ergonomy for all kinds of motor impairment
- Use standard interface elements where possible
  - Standard methods for contract adaptation
  - Standard methods for collaboration with aids
  - Standard ways to keep the “tabbing order”
- Limit the use of blinking
- Control all interface timing
  - commonly from a single constant
- Prevent errors caused by dysfunctions
  - spell checking, completions

# Summary

- Physical ergonomy – limit motor and sensory load
- Human biomechanics – pair of muscles, static and dynamic load, fast and precision movement, feedback control
- Human senses – logarithmic, adaptive
- Imapairments
- Methods to limit load and fatigue – posture, proper tasks for muscles, reachability, Fitt's law
- Special interfaces – adapted and alternative input, output

# HCI/UX, SOFTWARE ENGINEERING AND MARKETING

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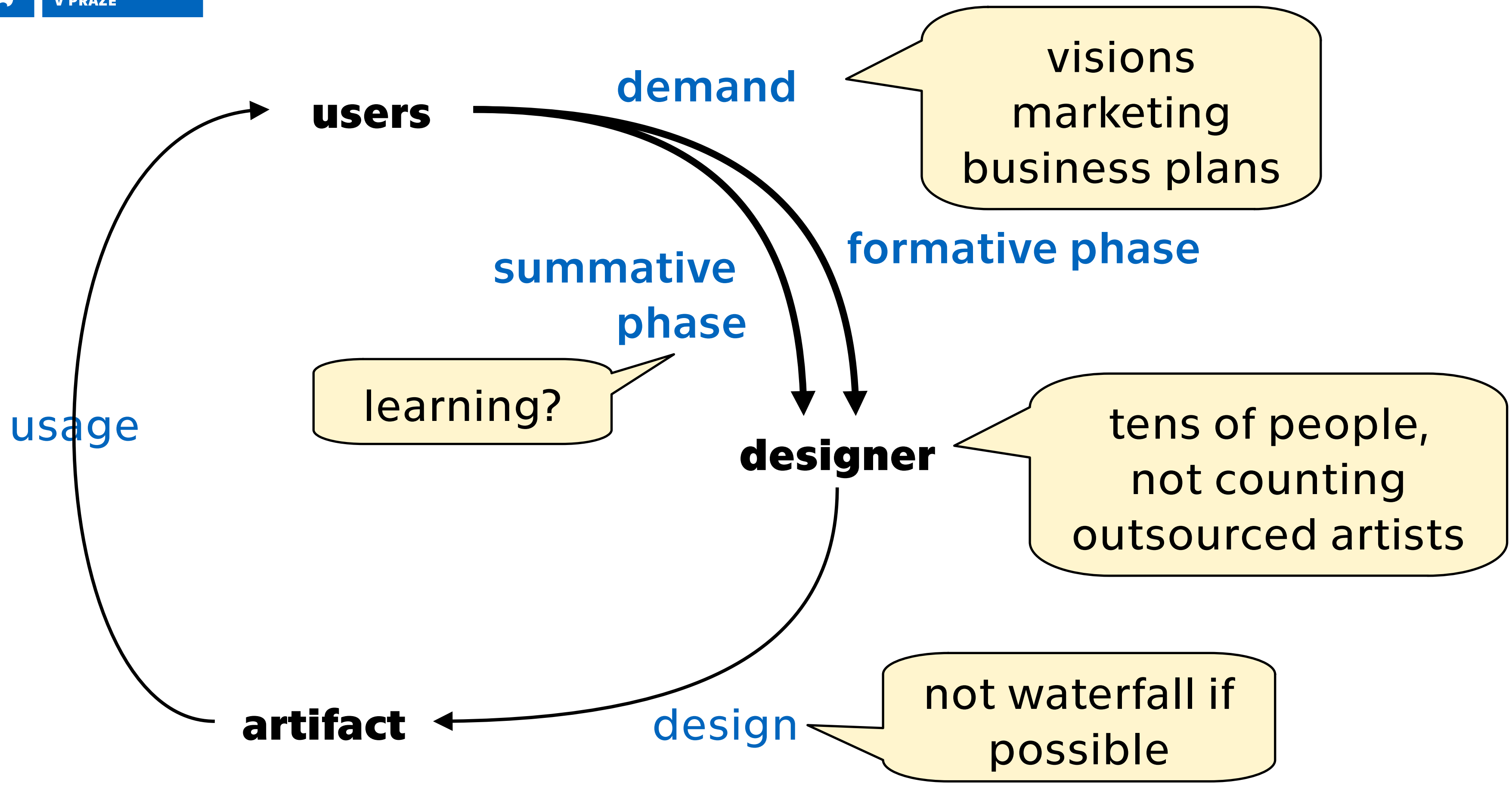
# Artifacts, design, society



- HCI/UX teams do not work in separation, they are a part of bigger enterprises. What are the consequences?
- The entire process of formative phase, design, deployment, and summative phase is in fact a part of the entire software development cycle, and is affected by its nature.
- The demand from users for an artifact is in fact the entire business planning process; involving marketing, business missions, etc.
- There can be no step of the software development cycle which corresponds to the summative phase of the HCI/UX work.
- The designer is in fact a large and heterogeneous team, often not even co-located.

# LINEAR SOFTWARE DEVELOPMENT

# Waterfall model (Royce)

The following steps are performed in sequence. The result of every phase must be correct before next phase starts.

- Requirements specification → a document
- Software design
  - → software architecture
  - → information architecture, interaction style
  - → UI logic, UI graphic
- Implementation → software
- Integration
- Testing, debugging
- Instalation
- Maintenance

# UCD in the waterfall model

- **Requirements specification** → a document
  - personas
  - user goals
  - context
- Software design
  - → software architecture
  - → **information architecture, interaction style**
  - → **UI logic, UI graphic**
    - prototyping, storyboarding
    - predictive testing
- Implementation → software
- Integration
- **Testing, debugging** — usability evaluation
- **Instalation** — user support
- Maintenance

# Logistic conflicts

- **The formative phase is typically long** and difficult to overlap with other activities
  - Coders tend to start **implementation immediately**, before an analysis is complete
  - Make an **early start**, before the rest of the project
  - But, in the meantime, the project can **change focus**
  - When the UCD people are not fast enough, incomplete and badly designed features follow
- The final summative phase can uncover **errors** in early phases

# Aiming conflicts

- Focus
  - Software engineering focuses on the customer,
  - UCD focuses to the end user
- Leaders
  - Waterfall development is governed by managers,
  - UCD is governed by creative people

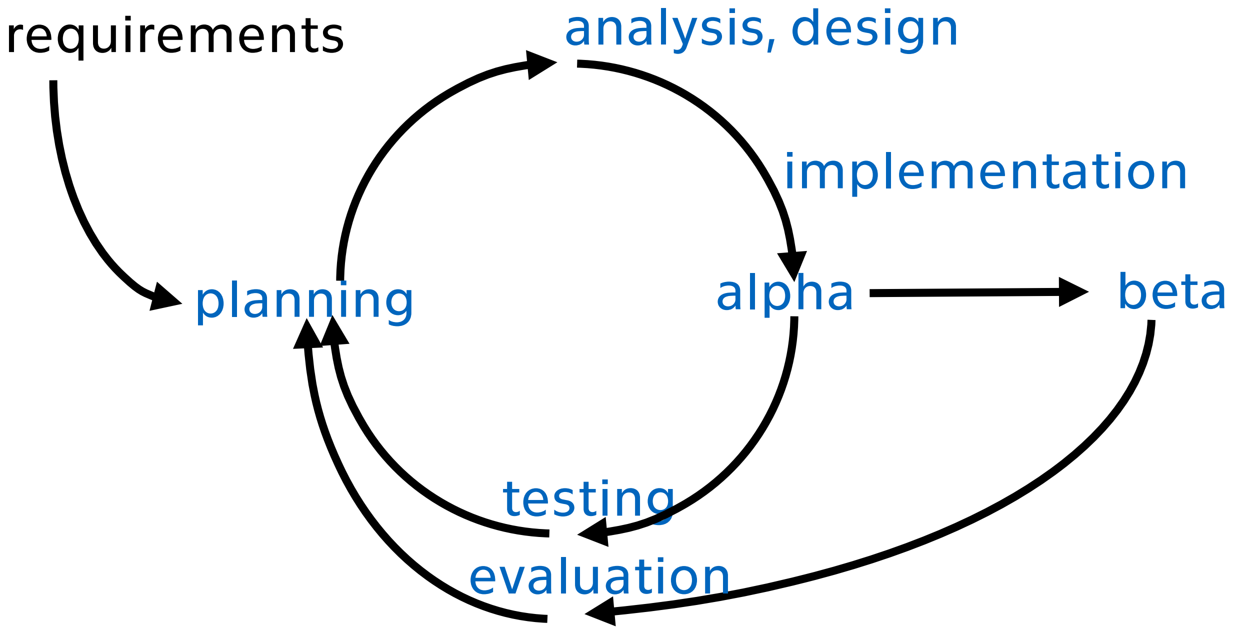
# User representation

- Traditional software engineering methods (Structured Analysis and Design Method etc.):
  - the user as an **object**
  - represented by survey results
- Modern methods (agile, iterative, Rapid Application Development):
  - the user as a team **member** („business champion“)
  - evaluates models, prototypes, software…
  - answers questions (domain expert)

# ITERATIVE SOFTWARE DEVELOPMENT

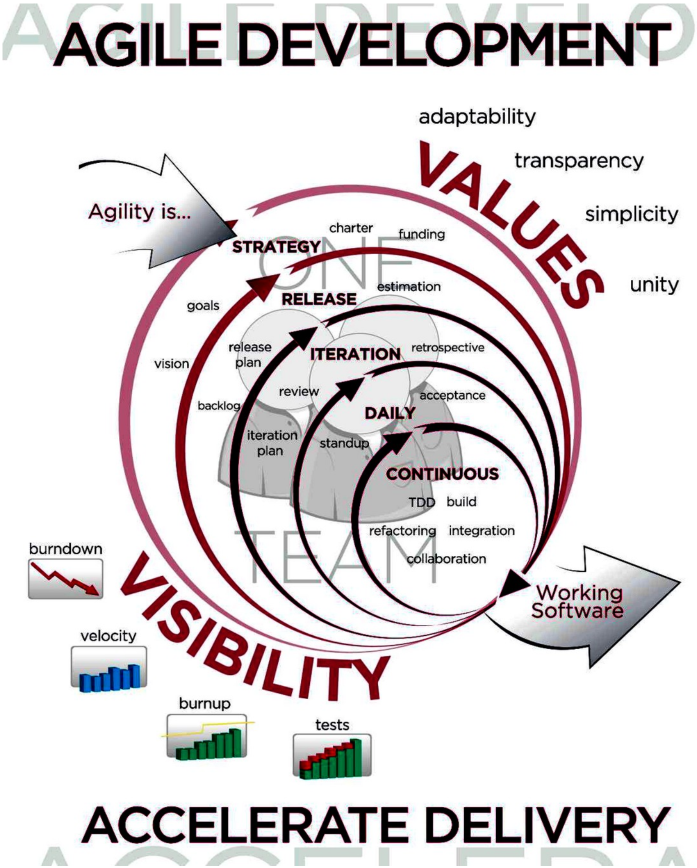
# Iterative development

- The principle is to use evaluation results in planning the next cycle
- Cycle length varies with the concrete method used




[source: Wikipedia]

# An example: Agile

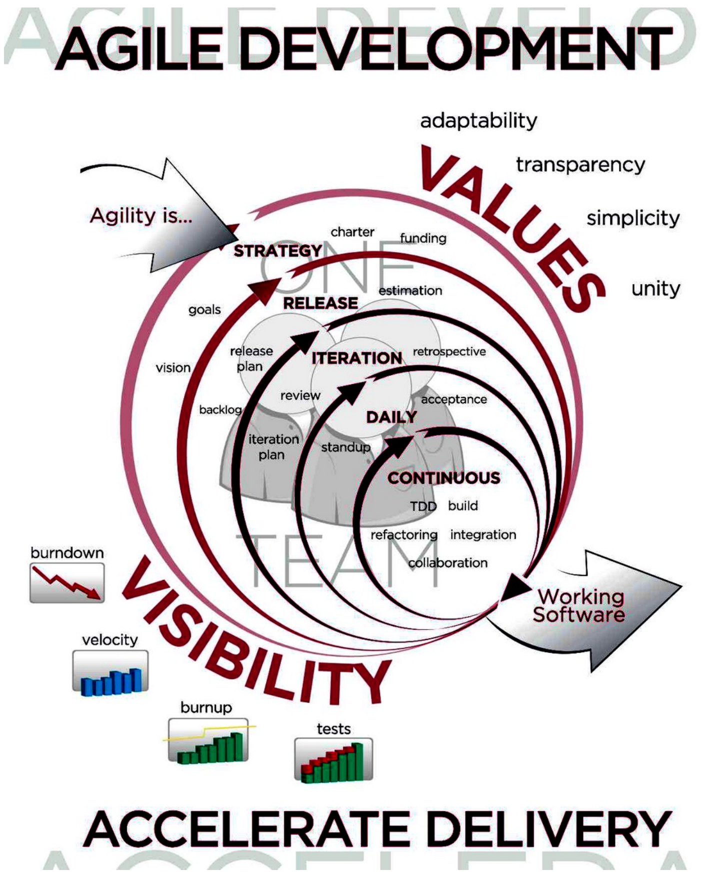



"We are uncovering better ways of developing software by doing it and helping others do it. Through this work we have come to value:

- Individuals and interactions over processes and tools
- Working software over comprehensive documentation
- Customer collaboration over contract negotiation
- Responding to change over following a plan

That is, while there is value in the items on the right, we value the items on the left more."

# Agile methods




- A typical sprint is 2-6 weeks
- Each sprint has a clear goal
- Methods used:
  - multidisciplinary
  - iterative
  - with emphasis on feedback
  - focusing on people before processes
  - valuing artifacts before documents
  - having users as team members
- **... and so is UCD**

# Users in agile development

- Positions
  - „Liaison officer“ – representing other users
  - Team members
- Communication
  - Users cannot understand specifications
  - **Working software** as the way of communication
  - Before the first version is ready: **comprehensible** and „live“ **models** – prototypes, comics (storyboarding), diagrams
- Fast release of artifact versions

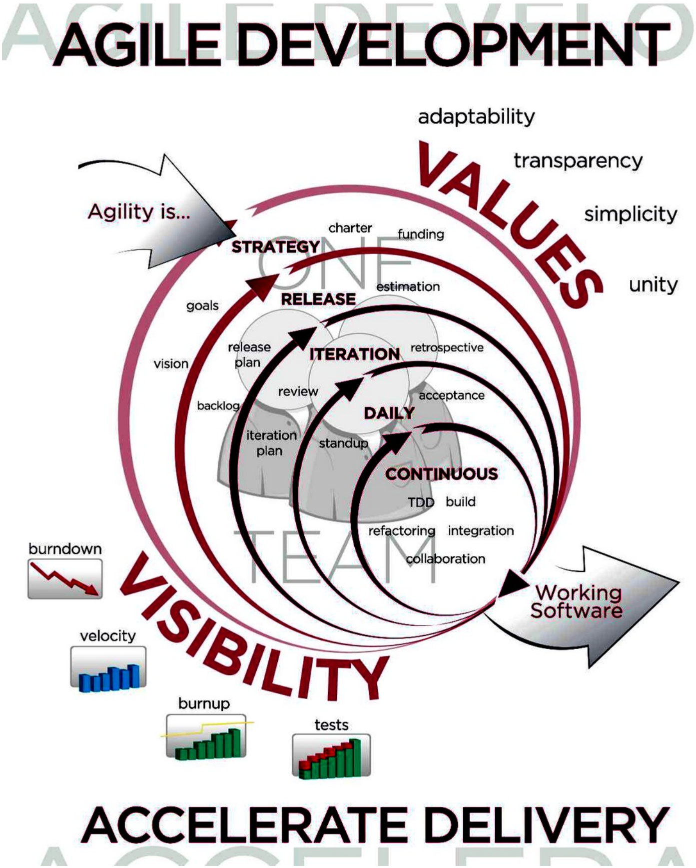
# UCD contributions

- Before starting (formative phase of the project):
  - storyboards, stories, user goals, etc. give the project its **direction**
  - personas aid developers to focus the project
- During design
  - evaluation and context analysis give the  changes their priorities
  - UCD methods aid in testing, evaluation, comparison

# UCD opportunities

- **Users in the team**
  - informal communication: prototypes, chauffeured mockups
  - informal evaluation: discounted usablility testing
  - information analysis – domain experts
- Adapting **granularity**
  - each sprint implements a feature(s)
  - a quick research targeted at that feature is needed
- Strong **tie**
  - the developers have no time to “adapt” the design
  - fast reaction to usability errors

# Agile: a failed rebellion?




- Agile teams are self-managing, need **experienced people**, not rituals
- How to start the development?
- How to keep it running?
- Agile methods can accelerate delivery, but cannot present **intentions, aims, visions,** because visions are not **functioning software**

# Logistic problems and solutions

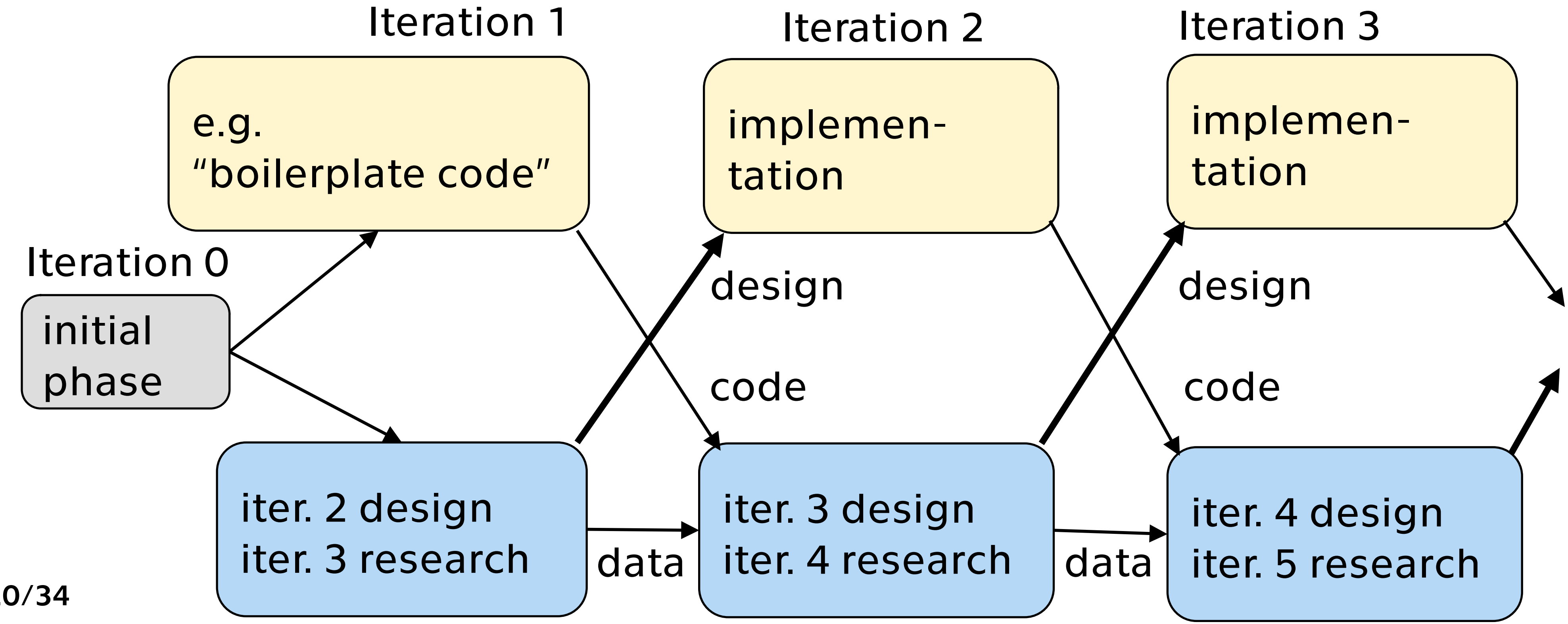
- **The UCD formative phase does not fit into rapid iterations**
- **Sprint agenda:** a dilema
  - correct detected errors?
  - make something attractive?
- **Sprint agenda:** HCI share?
  - new use of standard components → OK
  - complicated design → not enough time
  - other group of users → a tragedy
  - a problem with initial research → a catastrophe

# Formative phase solutions

- HCI starts well ahead of the project
- Often: HCI is **one sprint (three sprints)** ahead
  - but that is not "by the book"
- Do it fast:
  - Contextual inquiry as a focused dialogue takes hours, not days
  - A reaction to a change should not need a long formative phase (rapid, informal methods)
  - Decomposition of the design into components, parallel design
- When it does need time: other iterations while the research is performed

# Coding and design pipeline

Desirée Sy: Adapting Usability Investigations for Agile User-centered Design. Journal of Usability Studies, Vol. 2, Issue 3, May 2007, pp. 112-132



# Fast turnaround

- In initial phase, paper mockups are the fastest way
- Prototyping tools
  - unified for every phase
  - unified for all team members
  - unified over all platforms
  - the one and not those individually preferred
- Specifications show **intentions**, prototypes show **look**
- Collaborative tools whenever needed
- Prototype distribution support
- Feedback organization and support:
  - user annotations?

# Aiming problems

- Leaders
  - Agile development is governed by developers,
  - UCD is governed by creative people
- Feedback
  - The developers need not only prototypes, but understanding too
  - Lacking implementation feedback - unrealistic designs
- Usability problems detected – additional iterations

# Summative phase

- usability testing
- interpretive methods (field observation, interview …)
- monitoring, web analysis
- **lessons learned**

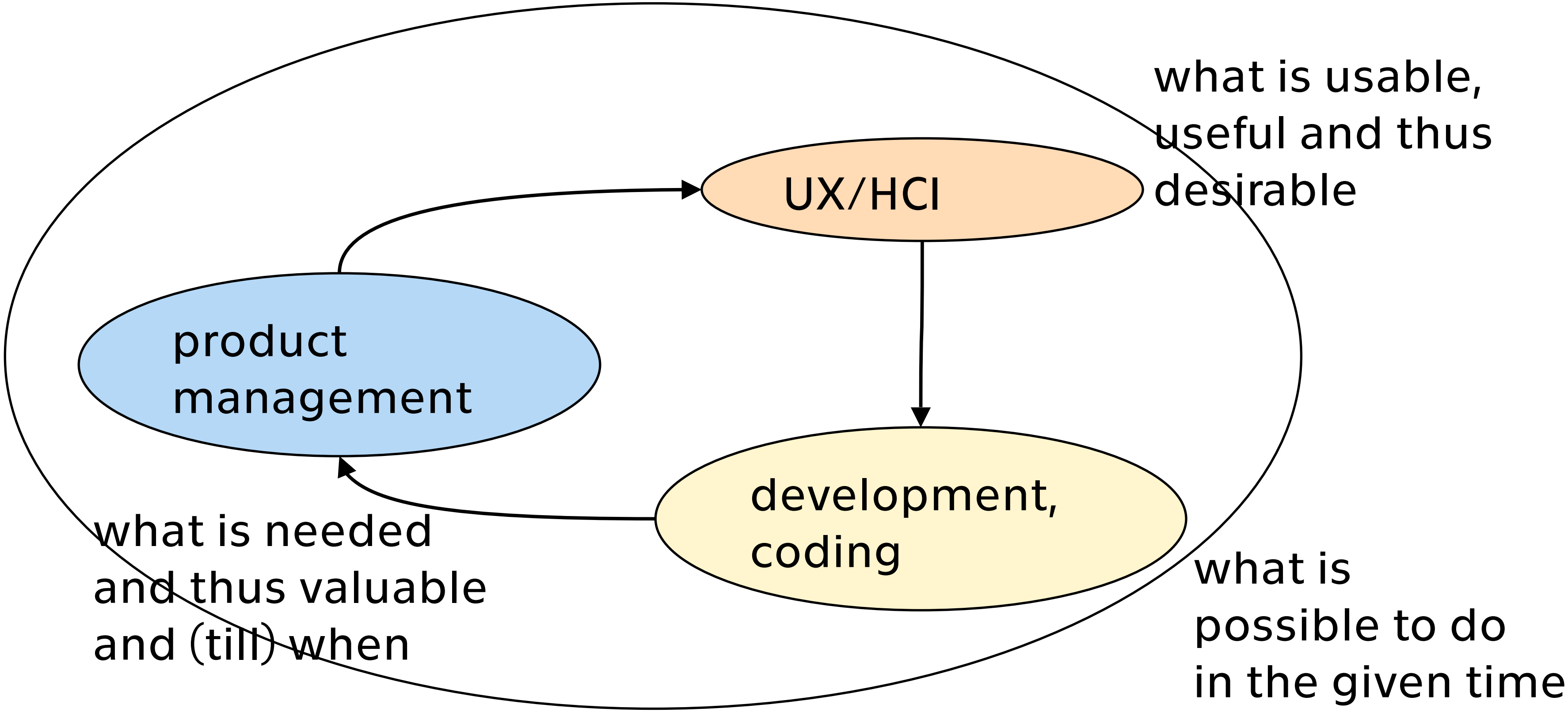
**Gentlemen, where is our contract for that??**

# MARKETING, USABILITY, AND DEVELOPERS

# Marketing and HCI

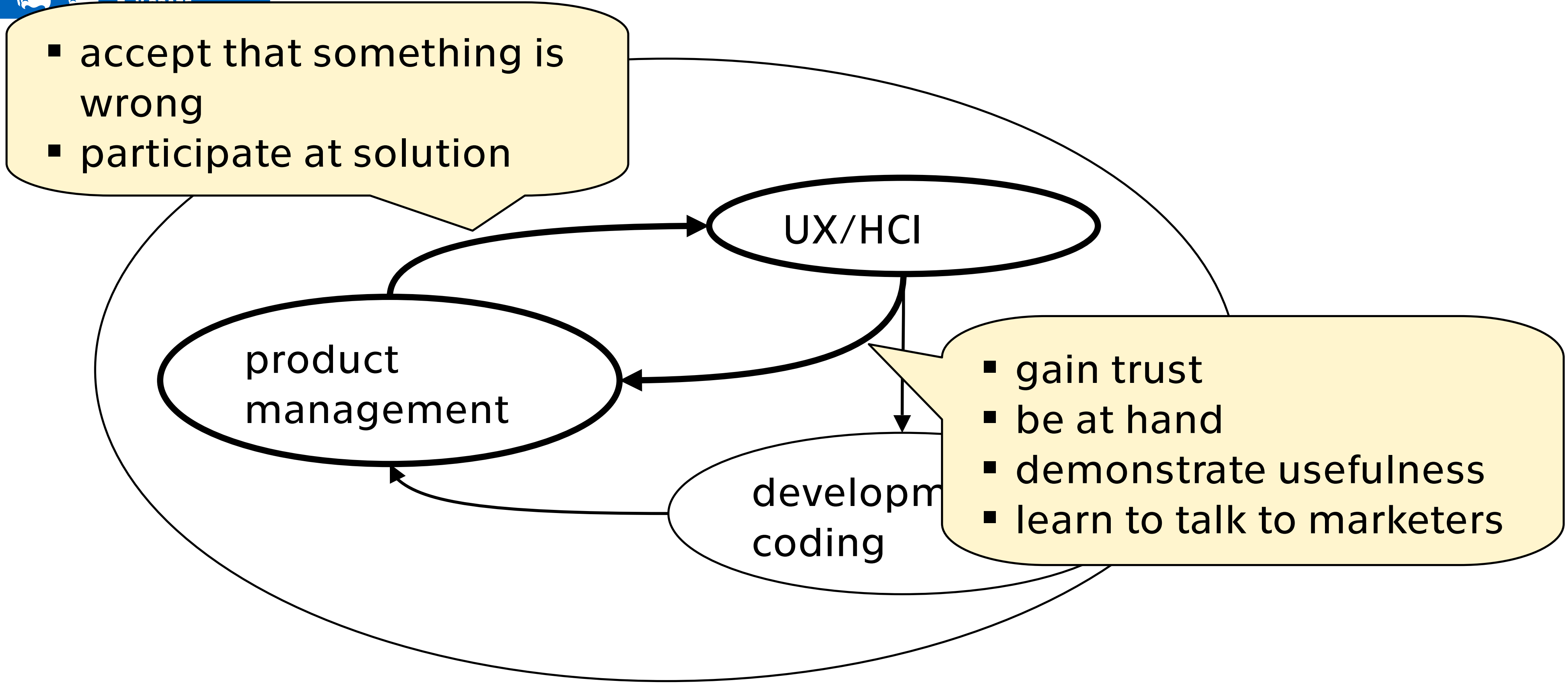
- A **synergy** with HCI:
  - a common goal (a usable artifact)
  - user needs
  - user preferences
  - ...
- **Similar techniques**:
  - focus groups
  - research
  - observation ...
- A **dialogue** is possible and needed

# A product means collaboration



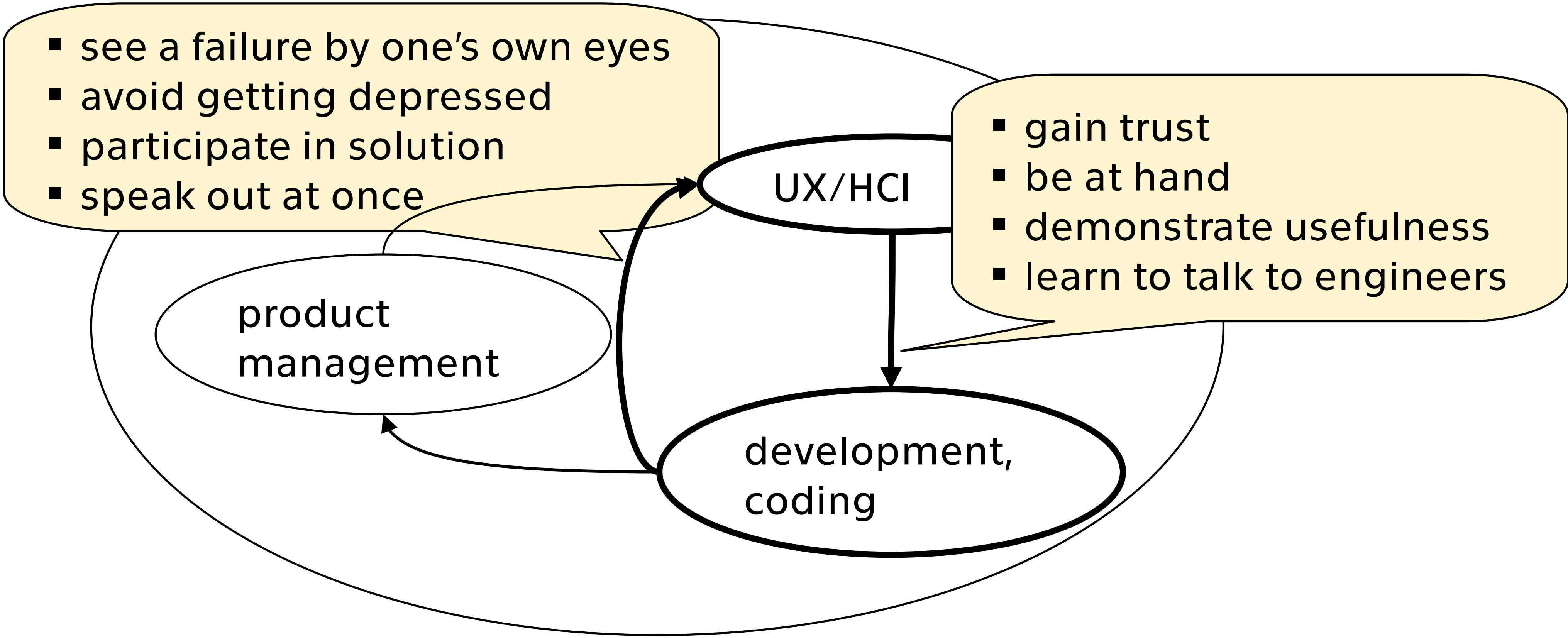
Pabini Gabriel-Petit

# Communication barriers



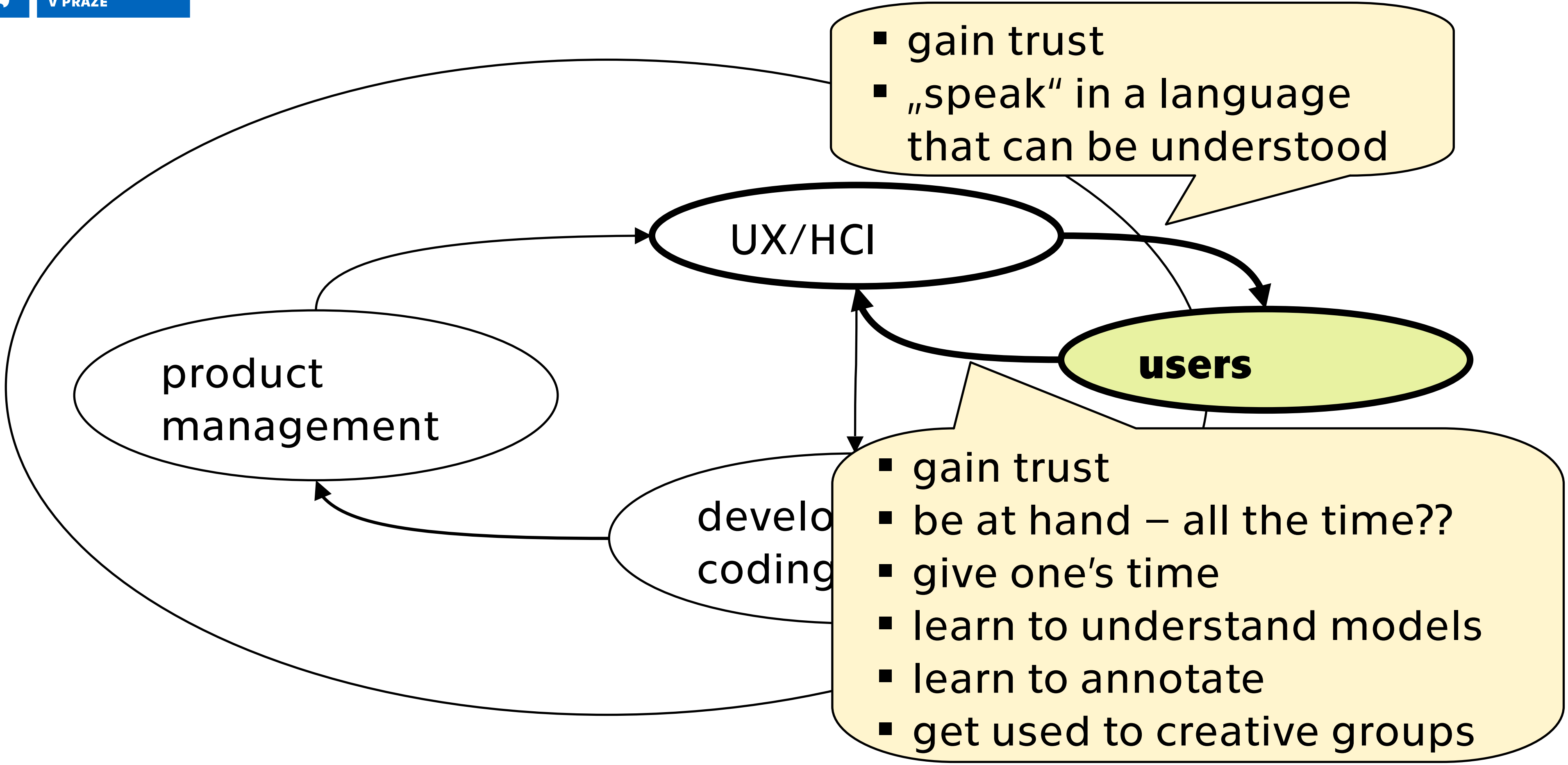
Pabini Gabriel–Petit

# Communication barriers



Pabini Gabriel–Petit

# … and those we already know



# HCI/UX at hand

- **A combined team**
- **HCI group** in an enterprise
  - need to plan and report work
  - one HCI team, more development teams - priorities?
- **Outsourced** group/expert
  - lack of knowledge from previous work
  - unrelated to enterprise culture
  - comes and goes
- **Agency/consultant**
  - minimizes direct contact
  - requires clear problem definition and contract
  - mostly, early phases only

# When marketing dominates ...

- **Competition wars:** superficial features, sales arguments, creeping featurism, featuritis
- **Prioritization** of features for a limited audience
- End of **visions,** micromanagement
- End of **synergy,** although
  - HCI  is synergetic: user needs, wishes
  - HCI has similar techniques: focus groups, user research, PR
- $\rightarrow$ Dialogue needed.

# When engineers dominate ...

- HCI design is just a suggestion:
  - We implement what we like
  - We implement it the way we like
  - We use space as much as possible
- A goodbye to
  - patterns
  - visual language
  - clustering

# When the artwork people dominate …

- We are gifted, talented artists!
  - This layout will be kept exactly to a pixel!
  - There is enough space on my monitor (32″).
  - Responsivity? What's that?

# When the HCI people dominate …

- We alone know what the users need
  - Our aim is the end user satisfaction
  - Who cares about the other stakeholders
  - This interaction has been designed with Usability in mind
  - Who cares about the volume of data and time needed to draw the screen

# PATTERNS OF BEHAVIOR PATTERNS OF DESIGN


FIT ČVUT, KATEDRA ČÍSLICOVÉHO NÁVRHU

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2023

1.0


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https://courses.fit.cvut.cz/BIE-TUR

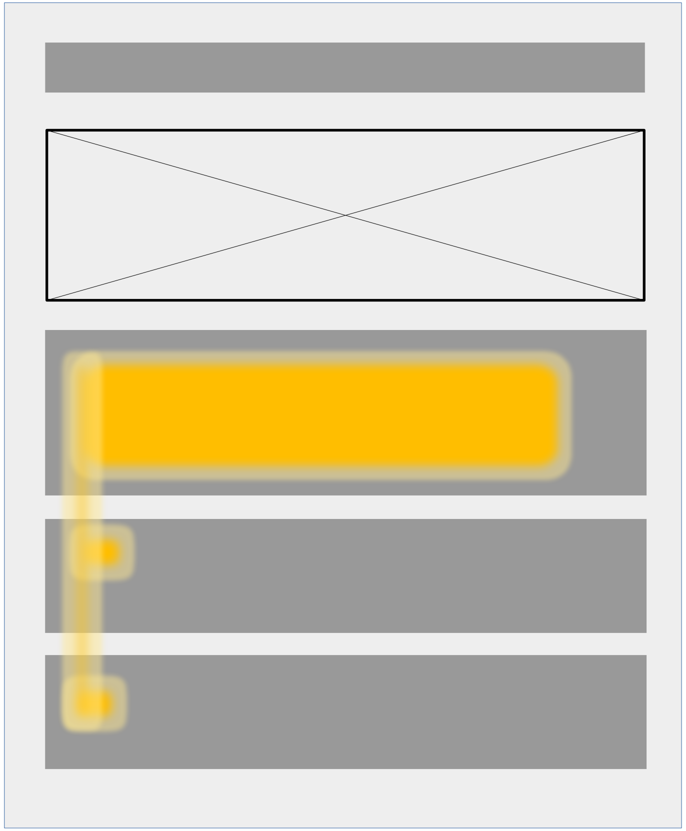
# USER ATTENTION

- https://www.nngroup.com/articles/text-scanning-patterns-eyetracking

# Page scanning patterns

- Users need to be efficient
- Users need to filter and/or search information
- Page reading pattern depends on
  - user task
  - user knowledge of the site/application
  - page content (text, images, controls)
  - page layout, attention-guiding elements etc.

# The F Pattern



- In the absence of subtitles and other attention-attracting elements
- The sequence:
  - first part of content, horizontally
  - other parts, briefly, horizontally
  - left side, vertically (can be the first)
- Attention span limited
- Follows the direction of reading (vertically inverted in RL countries)

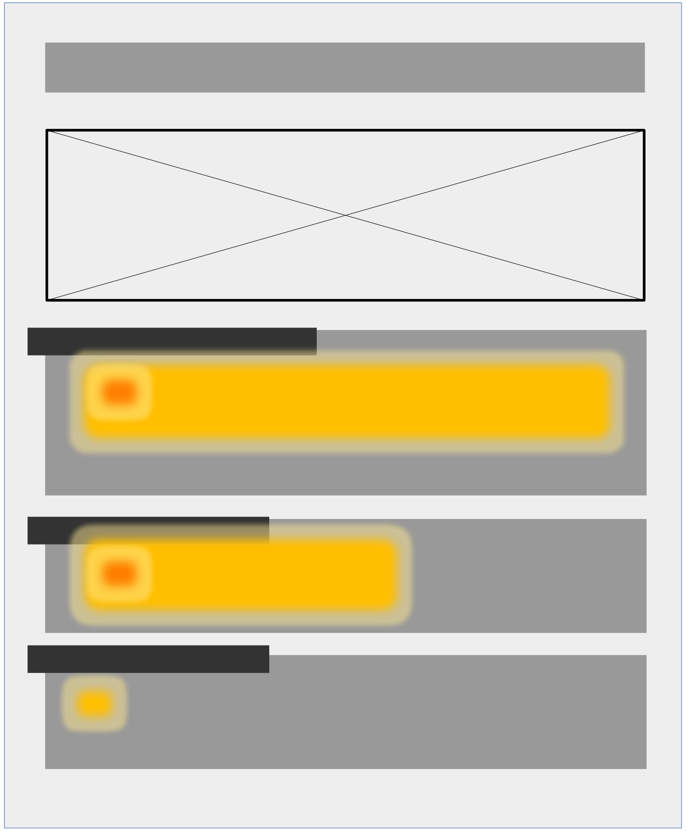
# How to avoid the F pattern

- Bad for users, bad for business
- Give the page a clear structure
  - divide content (chunking)
  - cut unnecessary content, long unformatted paragraphs
  - use distinctive headers, subheaders
- Catch attention
  - the first few words of a paragraph must be interesting
  - → thematic sentences in English paragraphs
  - use emphasis
  - use informative links

# A reminder: information scent

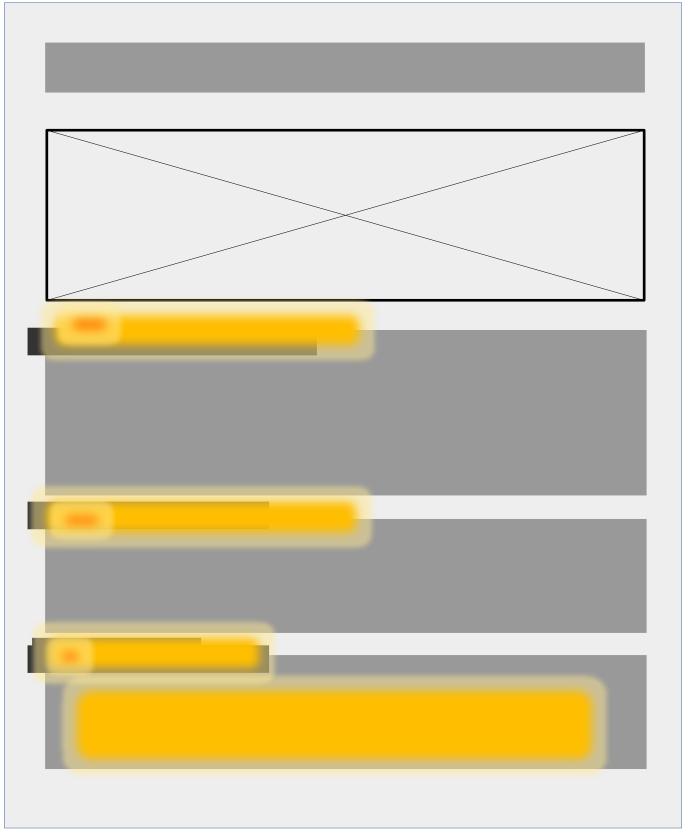
- **What the user sees**
  - **a label** (link, text, name, …): is it lexically related to the goal? → domain analysis → categorization
  - **nearby content:** a summary of the linked info, relevant picture, graphics
  - **context:** what does it mean w.r.t. the goal – a definition? an explanation? an example? a business offer? a request?
- **What the user knows**
  - experience with given environment (app), brand
  - experience with the current domain, arrangement, hierarchy

# Spotted Pattern



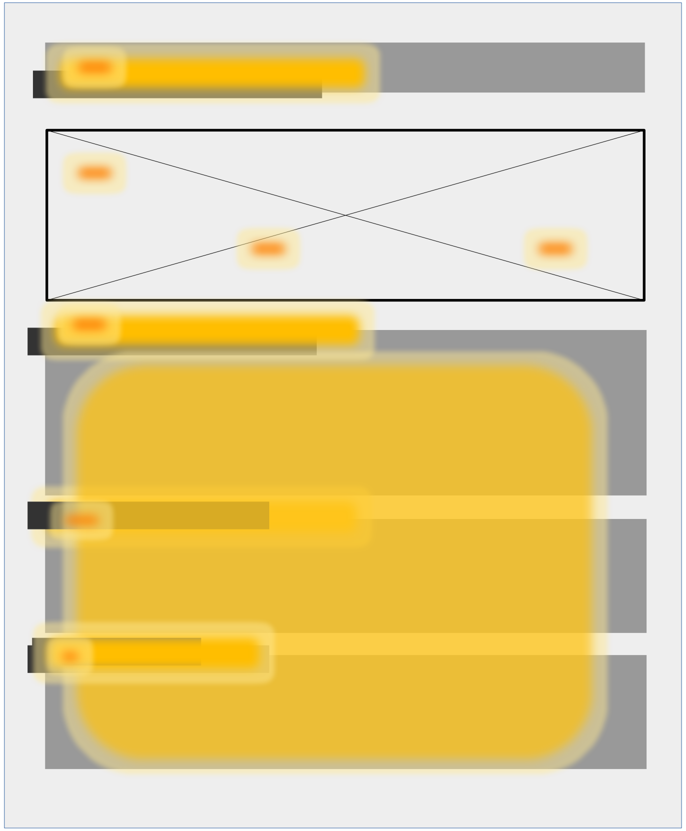
- Aided by subtitles and other attention-attracting elements
- Subtitles must have information scent (e.g. resemble an address when one is sought)
- Attention span extended but still limited

# Layer-Cake Scanning Pattern



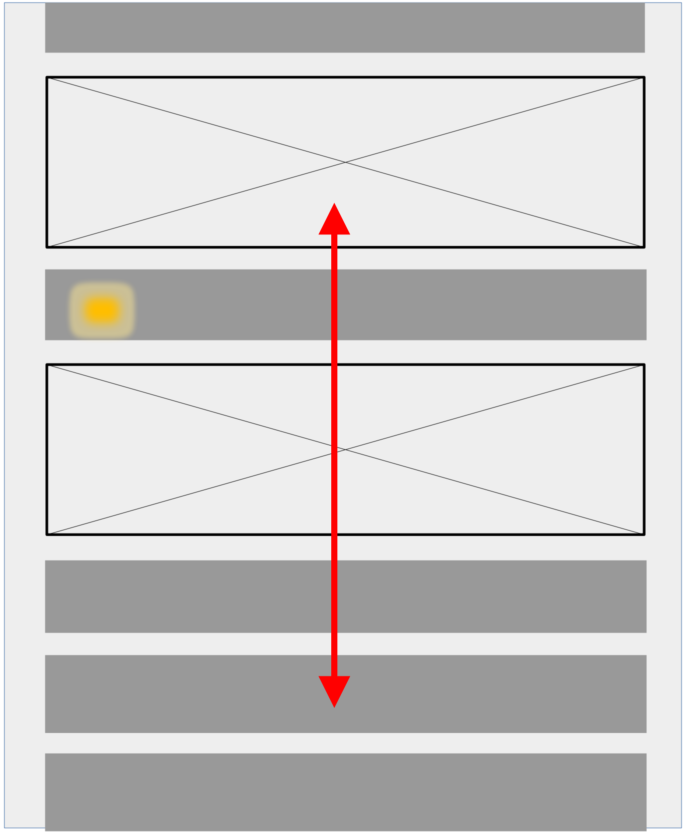
- Guided by subtitles
- Subtitles must work
  - lexically relevant
  - comprehensible
  - visually distinguished

# Commitment Pattern



- Careful (immersive) reading
- Requires trust
  - unbiased information
  - previous experience
  - external evidence

# The Marking Pattern



- Fixed attention, scrolling page
- Noticing:
  - lexical
  - visual

# Navigation and controls

- Users know that navigation is there
- Scanned only when necessary (navigation secondary to content)
- Similarly to controls

# USER COGNITIVE AND VISUAL PATTERNS

HTTP://UI-PATTERNS.COM/

# Cognitive patterns

- Already covered:
  - Loss Aversion
  - Negative Bias
  - Scarcity
- Other biases:
  - Endowment Effect: what is already owned/present seems more valuable than what is not
  - Illusion of Control: the ability to control a situation is overestimated, more by positive and self-confident people https://en.wikipedia.org/wiki/Illusion_of_control

# Memory patterns

- Recognition over Recall
- Isolation Effect – isolated elements are remembered better
- Anchoring – the most conspicuous element is memorized best, has more weight in comparison

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# DESIGN PATTERNS

UXPin: The 4 Main Types of UI Design Patterns
https://www.uxpin.com/studio/blog/use-right-ui-design-patterns/
Interaction Design Foundation: User Interface (UI) Design Patterns
https://www.interaction-design.org/literature/topics/ui-design-patterns

# Design patterns

- Common solutions and strategies for recurring problems
- Characterized by
  - the user's problem
  - the context or situation
  - the kind of sub(goal) – e.g. error recovery
- For the above, it provides
  - the solution
  - the reasons
  - (possibly) examples and implementation

# Abstraction levels

- Context
  - linked to a particular domain, user type, other context
- Flow
  - linked to user behavior patterns
- Implementation
  - reusable components
  - strict rules – platform libraries + HIGs, frameworks

# Typical problems – core functions

- **Input** – how the user interacts, or submits input, to the site, how the site responds, or submits feedback.
- **Data** – how the site/application organizes and displays information
- **Navigation** – how to guide the user around the site, to keep them oriented, how to find their way if lost.
- **Content Structuring** – how to make the content easy to access?
- **Social Sharing** – how to allow, promote, and facilitate the sharing of the site on any preferred social media.

# Beg, buy, steal

- Which problem do you have?
- How others solved that problem?
- What was their context?
- What other problems did it solve, what are the key properties?
- How to transfer the solution to your context?
- How to implement the solution?

# Example: Ratings Pattern

- https://technori.com/2013/02/3346-building-a-website-make-sure-you-choose-design-patterns-and-build-wireframes-first/

# Example, cont.

- What problem?
  - to get some feedback
  - to offer an opportunity to tell one's opinoion
  - to get qualitative and quantitative data from users
- How do they do it elsewhere?
  - Rotten Tomatoes (and how do we know that it is OK?)
- What other problems?
  - improving interactivity
  - connotates appreciation of users' opinions

# Example, cont.

- When to use?
  - feedback needed
  - quantitative and qualitative information needed
  - more interactivity desirable
- How to use?
  - preserve the logical (and visual) hierarchy
  - maintain average users' rating
  - offer the opportunity to change rating later
  - attract attention by „mouse over"
  - inform the user that the rating was received

# Frequently cited patterns

- Breadcrumbs
- Lazy Registration
  - reciprocity – give first, ask afterwards
- Forgiving Format
  - prevent errors
- Clear Primary Actions
- Progressive Disclosure
  - Hick law
- Hover Controls
- Steps Left
  - Gamification
- Subscription Plans
- Leaderboard
  - Social média
- Dark Patterns

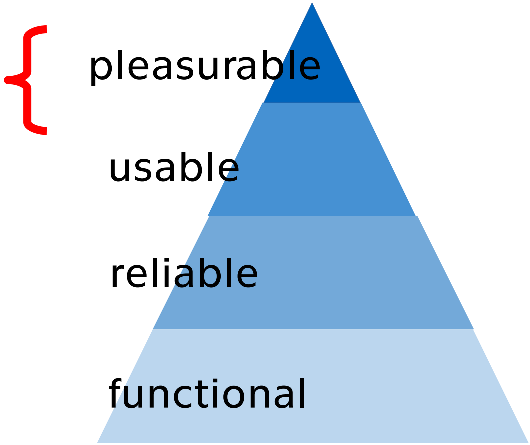
# Further resources

- https://www.uxpin.com/studio/blog/use-right-ui-design-patterns/
- https://www.uxlibrary.org/explore/ui-design/ui-patterns-and-inspiration
- http://ui-patterns.com/
- http://welie.com/patterns/index.php

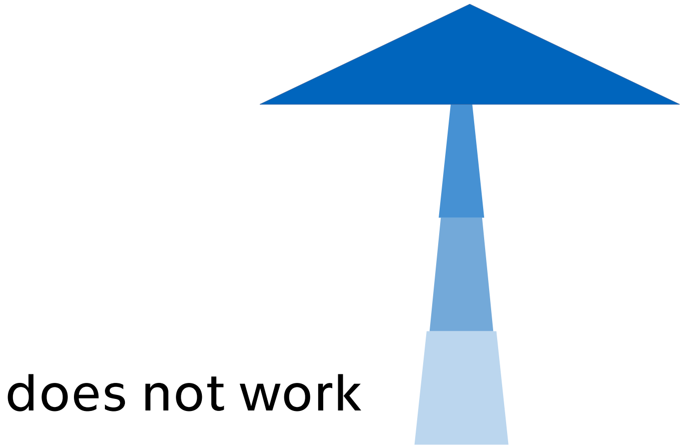
# Gamification

- Gaming elements in a non-gaming situation
- Gaming elements
  - Gaming structure (levels, realms, rooms)
  - Game rules
  - Leaders list, tags, ...
- Strengthens users' immersion

# Surface delight:
## a reminder




- Local, contextual
- Examples:
  - animation, sound response, illustrations
  - easter eggs – unexpected response, microcontent
  - gaming elements, gamification
- Surface delight **only**:
  loss of authenticity, loss of trust



# Balancing gamification

- Balance the gaming elements with content – do not create a game
- Functionality, reliability, usability of the app must be OK – gamification is no “magic paint”
- Choose rewards according to the target group (friends vs. intranet …)
- Do no manipulate
- Principles:
  - **Autonomy**: users must feel they are in control
  - **Competence**: users must feel they are able to fulfill the gaming elements
  - **Relation**: users must feel that the purposes of gaming elements are in accordance to their goals

# Dark patterns: ethics

- **The misuse** of users`  cognitive and visual patterns to **unethical** purposes
- Ethics: "a set of moral principles, especially ones relating to or affirming a specified group, field, or form of conduct"

*wikipedia*

- That is, a consensus
- Persuading the user
  - navigating to her perceived goal: most probably OK
  - marketing persuasion: consensus based on **common ability of critical thinking**
  - beyond common ability of critical thinking: considered unethical
- "In law, fraud is intentional **deception** to secure unfair or unlawful gain, or to deprive a victim of a legal right."

*wikipedia, emphasis JS*

# Dark patterns

- **The misuse** of users` cognitive and visual patterns to **unethical** purposes
- Creation and misuse of **incorrect mental model**
- Misusing **prioritization**: Defaults set to benefit the owner, not the user （Facebook privacy options）
- Misusing visibility: Hiding elements that benefit the user (unsubscribe)
- Misleading **mental model** of the purpose: using information from users to spam persons instead of finding them(LinkedIn - Medium post)
- **Hidden purpose:** hidden additions to the shopping basket

# Designing with patterns

- A design follows from context analysis
  - user research: aesthetics, preferences, background
  - user goals and pleasure
- A design has
  - an information architecture
  - an element hierarchy in each page
- A design is not
  - a random composition of unadjusted patterns
  - a slightly adapted design of a popular source